SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MARCH 6, 1903.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*INAUGURAL ADDRESS OF THE PRESIDENT OF THE STEVENS INSTITUTE OF TECHNOLOGY.**

IN subscribing to this oath of office I am profoundly sensible of the responsibilities I assume.

For the two months preceding my acceptance of the presidency of Stevens Institute I was constantly studying the many questions involved therein, and especially that of my fitness for the office. I feared that it would be presumptuous for a man not an educator by profession to undertake to carry on Dr. Morton's great work; at the best it seemed to me an experiment of doubtful wisdom, for failure meant probable injury to the loved *alma mater* as the return for serious sacrifices to be made by myself and those dear to me.

In considering the objection that I had not been trained as an educator, I was not unmindful, on the other hand, of the fact that in my professional career I had been called to direct the later studies of graduates of engineering schools, including a large number of Stevens men, and so had been forced to study and appraise from the viewpoint of practice, the efficiency of the training supplied by a number of our technical schools. In this work I had found myself deeply interested; and in reviewing my experiences in this and some other di-

* Delivered in the Carnegie Laboratory of Engineering, February 5, 1903.

rections in which I had been brought into practical contact with educational work, I was encouraged to hope that if I accepted this office my lack of training and experience in the school might in part be compensated for by these experiences and my sympathy with the aspirations of youth.

Finally my action was determined by the fact that the call was made by the trustees, faculty, alumni association and many of the alumni individually.

Since I have been in daily contact with the duties and responsibilities of the office I have been more and more impressed with the largeness of my undertaking and with the practically unlimited opportunities afforded for the exercise of a wise, patient, firm and energetic leadership.

As all this and more is included in my view of the situation, necessarily then I am profoundly sensible of my new responsibilities. But I must ask those at whose instance I have accepted this office to understand that they have not shifted their responsibilities to my shoulders. I shall look to them to help me to carry my new burdens and to be patient with me when I hesitate or stumble on the way.

As the circumstances under which I have accepted office are somewhat unusual, I have, at the risk of being misunderstood, decided to thus briefly refer to some of the influences under which I have acted.

The responsibility rests upon us all—trustees, faculty and alumni—to preserve and further extend and perfect that which has been so well built on the noble benefaction of E. A. Stevens. The admirable record which has been made during the thirty years of Dr. Morton's brilliant, wise and self-sacrificing administration will not alone carry the institute over the obstacles surely to be met in the years to come.

This reference to the work of our honored late president leads me to recall with a reverent sense of appreciation the devoted services of Professors Wood, Mayer and Leeds, who are with him now resting from their labors.

While resolving to zealously preserve and develop that which has been passed on for a while to our stewardship, let us consider whether this calls for any departure from the established ways. My four months' experience as acting president, added to that gained as alumnus, trustee, engineer and man of business, leads me to say emphatically that though there is much to be done, there is no change in principle or policy to be desired or tolerated.

The changes to be made are chiefly those called for by the increase in the number of students. A glance at the register shows that the equipment, methods and administration of twenty years ago are no longer adequate to meet our present requirements. Even with his own repeated benefactions Dr. Morton was unable to keep pace with the requirements as they developed.

The first ten classes graduated numbered as follows:

'73, 1; '74, 3; '75, 10; '76, 17; '77, 10; '78, 22; '79, 14; '80, 9; '81, 17; '82, 14. Total for first ten years, 117.

The last ten classes graduated numbered as follows:

'93, 43; '94, 39; '95, 45; '96, 64; '97, 63; '98, 57; '99, 53; 1900, 53; 1901, 40; 1902, 54. Total for last ten years, 511.

There have been 987 graduated up to date, of whom 54 have passed on to that other life where their records as engineers are only of moment as affecting their records as men.

These figures alone do not furnish a fair comparison and should be supplemented by a comparison of enrollments.

The enrollment at the end of the first ten-years period was:

Freshmen	53
Sophomores	47

Juniors	20
Seniors	12
Total	132

and the enrollment at the end of the last ten-years period was:

Freshmen	87
Sophomores	78
Juniors	48
Seniors	55
Total	268

The enrollment at the beginning of this school year was:

Freshmen	115
Sophomores	69
Juniors	62
Seniors	50
Total	296

Though by these last comparisons it appears that we have only something more than double the number of students to care for than we had twenty years ago, the practical facts are that in our upper classes we have nearly five times as many to instruct; and, as most of our class- and lecture-rooms can accommodate only about fifty students, the lower classes have to be taught in sections, requiring the professors and instructors to duplicate much of their work.

This all means that we need larger class- and lecture-rooms, larger chemical and physical laboratories and shops, a general auditorium, additional equipment and additional instructors.

Another addition, which should be made, is at least one dormitory.

To complete our course in four years requires of the students hard work and long hours. It is thus incumbent on us to do our utmost to keep the students in good working condition, mentally and physically.

To this end they should have cheerful, comfortable, sanitary, though simple, lodgings, and plain, wholesome and attractive food. Men so cared for and provided with facilities for intelligent recreation should be able to safely undertake a large amount of work, and should be less liable to seek relaxation in harmful pleasures.

I am most anxious to promptly secure such an addition to our plant as will enable us to offer these more attractive and elevating surroundings to those of our students who in coming to us are cut off from home influences.

This would add to the cares and responsibilities of the administrative officers, but it would also give us additional opportunities to influence the students for good.

It would also tend to cultivate a healthier college spirit and to attract more men from the several sections of the country, which would in itself be broadening and mellowing to the student body.

On the basis of the present fees for instruction the original Stevens endowment was at first ample to furnish the additional income required to meet the difference between the yearly expenses and the income from students. That difference now amounts to about $100 per year per student. The original endowment would now be entirely inadequate to meet our developed requirements, and even with the additions made by Dr. Morton from time to time, aggregating $150,000, the Carnegie Laboratory and its special endowment of $100,000, $30,000 given at the time of our twenty-fifth anniversary by Mrs. E. A. Stevens, Sr., and other additions by members of the Stevens family, our endowment is insufficient to meet present needs, to say nothing of the additions required to be made to our plant and our teaching staff as already outlined. Expenditures which the trustees, upon my earnest recommendation, have already authorized lead me to fear a deficit at the end of this school year. Against this it is encouraging to note that provision is already being made to meet some of the deficiencies in our plant.

Before Dr. Morton's death $60,000 had been subscribed by him and the alumni for a laboratory of chemistry. This amount proves under present market conditions insufficient for the purpose, and I am now applying to the alumni—and the alumni alone—for an additional $60,000 to enable us to build and thoroughly equip a laboratory which will equal, if not surpass, in practical efficiency anything of the kind in the world. This is a large additional sum to ask from such a small body of men, the majority of whom are young and working on salaries; but if we succeed—as I believe we shall—this addition is to be named the Morton Laboratory of Chemistry, and it will serve as a most fitting memorial of our late president.

In moving into the Carnegie Laboratory of Engineering we set free the ground floor of the main building. At comparatively small expense this can be arranged to afford an excellent location for larger and more efficient shops. Moving the shops from their present location would set free the old auditorium, which with certain changes and additions could be restored to its original purpose and provide for an audience of seven hundred. This change, including some additional tools and certain other minor, but much-needed, additions to our plant, could be effected for a cost not to exceed $25,000; part of this has been subscribed contingent upon the whole sum being pledged.

One important step has been taken towards the beginning of dormitory life. Col. E. A. Stevens, our trustee, and his brother Robert L., sons of our founder, have notified me that a piece of land, 200 x 100 feet, which they jointly own in the block adjoining the institute's property, admirably located for the purpose, will be deeded to the Institute provided we can promptly erect thereon a dormitory. Preliminary plans have been drawn for a group of three buildings, which can be erected separately or together, as circumstances demand or warrant. One of these buildings would contain a refectory to cater to all the students lodged in the three buildings. Each unit in this group could be well made to serve as a separate memorial and named accordingly. I believe the cost of one of these units could be quickly pledged if pledges for the other two could be obtained. The entire group would accommodate about 110 students, and would be sufficient for our present needs.

This would not only greatly increase the efficiency of our plant, but would considerably add to our income.

What I have said will serve to correct the opinion held by many that our endowment is sufficient for our needs. There are some who know more or less completely of those needs, but hold, as I believe, a totally unwarranted opinion as to where we should look for relief. After considering the question long and carefully, I have decided to openly combat this opinion: namely, that as the institute carries the name of Stevens, the heirs of E. A. Stevens should be responsible for its support. This strikes me as a most unjust proposition.

E. A. Stevens bequeathed $650,000 and a block of land for an institution of learning. So well has this trust been administered that a new line of educational work has been developed, and the success achieved has created the demand for the increased facilities I have just mentioned.

Because the world has secured through the original endowment so much more than could have been reasonably anticipated, does that furnish a reason for demanding from the heirs of our founder, after the balance of his fortune has been divided into many parts, that they keep pace with this

constantly increasing financial requirement by constant additions to our endowment?

Rather, it seems to me, that because of the great work accomplished primarily through the instrumentality of the Stevens endowment, the community and those who have directly and indirectly profited by the advances made in technical education during the last thirty years—and it would be hard to find in the United States those who have not so profited—owe it to E. A. Stevens, his heirs, Dr. Morton and those who as trustees and instructors have faithfully worked with him, to provide the means to maintain, extend and perfect that which is already a powerful agency for good.

I have gone so far in speaking on a somewhat delicate subject, I may as well go farther in the hope of disposing of this question once for all.

It has been further suggested, that as the institute carries a family name, we have but little chance of securing aid from sources outside of that family. I do not doubt that this may influence some narrow-minded men against coming to our relief. But we can show against this that it has not stayed the helping hands of Henry Morton and Andrew Carnegie.

The evidences are on every side that our rich men are exercising more intelligent discrimination in the effort to secure full returns on their philanthropic investments. As with their personal investments, they are coming to investigate in advance, to make as sure as possible that their benefactions will secure full returns in perpetuity. To such a man it could be readily shown that a million dollars added to our present endowment and plant, would give a far greater return than could possibly be derived from the same amount employed to establish a new institution.

And now why should not the name of 'Stevens' be attached to our institution? Our original endowment was a large one for the time when it was made, and it was most natural that the institute should have been named after our founder, though it is a fact that some of the family opposed that course. I can say that, while in my opinion any change would be most unwise, the Stevens family would be the first to urge a change if they believed that a majority of the alumni were in favor of it, or if by so doing we could secure the cooperation which would enable us to enlarge our usefulness. But it can not be supposed that the alumni would be willing to surrender the prestige which is theirs through being known as graduates of Stevens.

If we must consider the question of name, it should be seen that we offer an advantage rather than otherwise. Such an addition to our endowment as I have spoken of would be naturally individualized under the name of the donor. That name would not be alone, but would stand with the three great names—Stevens, Carnegie, Morton—and this should attract rather than repel.

In estimating our future requirements we should not fail to recognize that there has been within the last few years a marked increase in the demand for technically educated men. It is beginning to be recognized that the commanding position which the United States to-day holds in the fields of industry and commerce, is in considerable measure due to the intelligent and conscientious work done during the last thirty years by our technical schools.

While our country has benefited by a unique combination of natural advantages, it needed the men technically educated, working in an atmosphere most favorable to the full utilization of their best powers, to secure from these conditions the exceptional prosperity of to-day.

We can better appreciate our advantages, both as to superiority in the line of

technical education and freedom from the trammels of caste, when we compare our condition in these regards with that of Great Britain; yes, and even with that of Germany.

This increase in the demand for scientifically trained engineers is evidenced by the fact that whereas thirty, and even ten, years ago employers could select from the graduating classes to meet their requirements, to-day many concerns now accept these graduates and apply for them a year in advance, without being able to exercise any such selection. This has resulted in creating some question in the minds of certain employers as to whether our methods are now as efficient as in the past. Naturally they find that the cadet engineers they now hire without the advantages of selection do not average as high as those engaged in years gone by.

This does not at all mean that every young man must succeed because he is a graduate of Stevens or some other good engineering school. It only means that his diploma will give him the opportunity to prove the stuff of which he is made.

Since Stevens Institute was opened many new engineering schools have been organized, and the departments of applied science in many of our universities have been so developed and improved that they have in some cases become the very life of the universities with which they are connected.

As we contemplate this change we may be tempted to question whether our little school has a work to perform which can not be safely left to others. Then let us remember how many there are in this vast and growing country requiring, for the nation's good, to be educated in applied science. In thirty years Stevens has placed less than one thousand men in the industrial ranks. There is room and more than room for all of these schools, and we may well wish them all Godspeed.

If some time in the future it were found that there were more than enough technical schools to supply the wants of this great country, the country should be the gainer, for the fittest only would survive. And if under this searching test it were found that we were unable to show a reason for our continued existence, we could at least take comfort from the reflection that we had helped in no mean degree to make possible the progress in educational methods with which we had finally been unable to keep pace.

But I prefer to believe that, let the standard be developed never so high, Stevens will be found steadily in the van.

In the past there has been a tendency in our technical schools to specialize too closely. Graduates of technical schools are sometimes to be heard regretting that they had not first taken a B.A. course. Part of this is no doubt a well-grounded regret occasioned by a too narrow training, but part of it is the natural inclination we all experience to long for that we do not possess, and lightly regard that we have grown familiar with through years of use. No doubt every possible effort should be made to include in the engineer-student's curriculum all that the four years will safely contain of such non-technical studies as will be best qualified to make the course broad as a whole. But let us be careful that the reaction from the fault of too close specialization does not carry us to the other extreme.

First our students should be thoroughly and completely trained in the fundamentals required in the practice of their profession. They must be given a *working* knowledge of the higher mathematics and an accurate knowledge of the fundamental laws of nature; and throughout the course they must be trained to apply in the drawing-room, the shops and laboratories, the mathematics, chemistry and physics (espe-

cially mechanics and electricity) learned in the lecture- and class-rooms.

That is to say, there must be as complete a coordination of theory and practice as is possible in an institution of learning.

The tremendous activity in the industrial field creates a constant pressure for the inclusion in our course of closer specializations within our specialty. As our course is now so crowded that no additional work can be safely included without the elimination of an equal amount, this pressure, if not resisted, will almost surely result in the slighting of the essential fundamentals.

As in the past we have stood for the harmony of theory and practice and thoroughness, so we have stood for concentration on one broad course in mechanical engineering. While we have thus differentiated from the other broader divisions of the engineering profession, such as civil, mining and electrical, we have covered much that is included in these other divisions.

In any case we can not expect to graduate our men as engineers. As they get out in the world probably natural bent or necessity will lead most of them to further specialize. If so and they have taken advantage of the opportunities we have offered them and even forced upon them, they will find they are able to quickly and surely build upon the broad and strong foundations they have here laid.

There are certain studies which can not be properly or safely omitted from any engineering course, be it mechanical, civil, mining, electrical or any other. I should include in this list English, logic, history, modern languages, economics and business methods.

Outside of the question of culture, an engineer needs a working knowledge of his own language. He must be able to convey to his employers or associates in language concise and explicit the results of his work or investigations.

In the department of economics he should at least have sufficient insight into the science to guard himself against the danger of drawing conclusions from insufficient or inconsistent data.

He should have such a knowledge of business methods, and especially the principles of accounting, as to qualify him to exercise a close and independent supervision of manufacturing cost. He must appreciate the necessity for and be capable of instituting a system of charges, based upon a complete study of local conditions, to provide for the depreciation of plant and stock; he must appreciate the danger of confusing capital or investment items with revenue or expense items.

While we can not expect to give the engineer-student a working knowledge of the law of contracts, we should try to give him such instruction as will serve to warn him of the pitfalls to be avoided, and to impress him with the wisdom of seeking competent legal advice in all cases outside of established routine.

All this and more must be covered in a course which claims to harmonize theory and practice, for the engineer who is most practical in the shop may be most unpractical in business affairs—and here it is to be understood that the engineer must find his success within the limitations of commercial conditions.

Much of this part of the instruction may well be included in lectures on engineering practice, and preferably these lectures should be delivered by men who have themselves been successful as engineers and speak from that standpoint; for it is most difficult to impress upon students the necessity for the inclusion of these subjects in a course of engineering study. This applies particularly to the study of English, and every possible effort should be made to

quickly impress upon the freshman classes the reason why English is necessarily included in the curriculum; unless the sympathy of the students can be promptly secured in connection with this difficult study, there is but little hope that much good can be accomplished in the time available.

To do in four years all the work which has been here most briefly outlined the student should be strong mentally and physically and be possessed of a definite purpose.

There is danger of overstrain, but I firmly believe the danger of injury is less than in the case of the courses in some of our universities, where, according to our own observation, confirmed by the views lately expressed by a number of the university presidents, the students can take their B.A. degree in four years without any sustained effort. This is an enervating influence to which many young men can not safely be subjected. Our students are better able to sustain the strain to which we subject them because they average in years somewhat higher than those entering the universities for the first degree. Our last three classes averaged, respectively, at entrance, 18½ years, 18⅓ years and 18¾ years; a general average of say 18½ years.

This brings the average age of the graduate to more than 22½ years, as there are more of the younger students than the older who drop by the way.

This should dispose of the question of lengthening the course to five years, except in the case of the few who are specially qualified to carry on work in engineering research.

There can be no question that during the next decade we are to see many changes in our educational methods. We must here be prepared to listen to all suggestions with an open mind, and then be careful not to act rashly. During the last quarter century there have been in the United States not a few false moves made in our educational schemes, and especially has there been a tendency at times to spread out thin at the expense of thoroughness.

In looking over the list of our alumni and the work they have performed and are now performing, we can obtain therefrom enough encouragement to warrant us in moving slowly when radically different methods are suggested for our adoption.

When we think of these changes to come we may well hearten ourselves by recalling that many of our great universities and important colleges and separate technical schools are under the direction of men who are statesmen as well as scholars.

While it is our duty as teachers and guides to see to it first that the men entrusted to us should be producers and not dependents, that the problem of self-support should first be honestly and squarely met, we should further endeavor to cultivate in them aspirations for the higher things of this life and the life to come.

The motive for the struggle for success may at first be largely selfish, but, as we all can acknowledge with gratitude, from lower motives can be evolved those of a higher order.

While we of the faculty can not give our students religious training, we can be careful to set them an example of absolute honesty and straightforwardness. We can best eliminate meanness and trickiness from the student body by being ourselves candid, just and, as far as our natures will permit, sympathetic. We may well recall the names of the headmasters of certain schools whose influence upon the lives of their scholars has been potent to the end. It was not the curriculum or the system of teaching which made these schools so effective for good, but the personal influence of these men who were deeply sensible of the responsibility

of being entrusted with these young lives during the formative period.

Even in a school like ours the faculty can exert a strong personal influence for good and can, if they will, create an atmosphere of honesty which should be of special benefit to the students in connection with that vexed question of examinations. The responsibility for honest examinations first rests on the examiners. And we must remember that the man who is not honest in the class-room defrauds his *alma mater* and weakens and debauches his own character.

God grant that such an influence shall always be around the students of Stevens, and that so they may go out into the world not only honestly trained to take their places in the engineering profession, but also influenced to do their whole duty as citizens and self-respecting, God-fearing gentlemen.

ALEX. C. HUMPHREYS.

THE SOCIETY OF AMERICAN BACTERIOLOGISTS.

THE fourth annual meeting of the society was held at the Columbian University Medical School, Washington, D. C., on December 30, 31, 1902. Abstracts of papers* presented at the sessions of the society follow herewith:

Contribution to the Study of Agglutinins: W. W. FORD and J. T. HALSEY. (From the Pathological Laboratory, John Hopkins University.)

Experiments were undertaken to determine which constituent of the red blood corpuscle takes part in the production of lysins and agglutinins when the blood of one species of animal is used to immunize another species, Bordet stating that the stroma was responsible for the lysins, Nolf maintaining that the stroma was responsible for the agglutinins, the laked blood for the lysins. In the present experiments rabbits and guinea-pigs were immunized with the stroma and the laked blood of hens; guinea-pigs with the stroma and laked blood of rabbits; rabbits with the stroma, the laked blood, and the washings from the stroma, of the goose; and rabbits and guinea-pigs with the hæmoglobin of hens' and dogs' blood.

For the preparation of the stroma and the laked blood, the blood was washed with isotonic salt solution, laked with two to three times its bulk of water, made up to one per cent. salt solution, and centrifugalized to separate stroma from aqueous solution. Stroma was then washed repeatedly with water made up to one per cent. salt solution or with isotonic salt solution.

For the preparation of hæmoglobin the blood was collected in ammonium oxalate, washed, laked with distilled water, centrifugalized to get rid of the stroma, treated with 25 per cent. absolute alcohol, upon the addition of which the crystals of oxyhæmoglobin are deposited at 0° Centigrade. The dog's hæmoglobin crystallizes readily, the hen's hæmoglobin with some difficulty.

The results of the experiments showed that in all cases the animals immunized with the laked blood and the stroma from rabbits and from hens developed in their sera agglutinins and lysins both far beyond the limits of normal variation, so powerful that frequently in dilutions of 1–100, always in dilutions of 1–50, complete agglutination and lysis took place. The rabbits immunized with goose's blood stroma and aqueous solutions developed agglutinins only—no lysis taking place. The agglutinins were present in very high dilutions, at times 1–10,000, always in dilutions of 1–1,000. Normal rabbit's serum agglutinates goose's blood in dilutions of 1–250 or 1–330. The attempt to supply a complement for a hypothetical amboceptor

* The abstracts were prepared by the authors.

with hen's, rabbit's and guinea-pig's sera was unsuccessful. The animals immunized with dog's hæmoglobin possessed, after repeated injections, a serum not differing from the normal, while the animals treated with hen's hæmoglobin developed agglutinins and lysins present in dilutions of 1–100 parts.

On the Nature of 'Pyocyanolysin': E. O. Jordan, University of Chicago.

A number of bacteria, including pathogenic forms like the tetanus bacillus, and ordinary saprophytes like *B. megatherium*, have been reported as producing hæmolysins in their broth cultures. *B. pyocyaneus* is one of these forms, and 'pyocyanolysin' has been generally considered as belonging in the same general category with tetanolysin and staphylolysin.

The well-known laking effect of alkalies and the fact that old cultures of *B. pyocyaneus* possess a strongly alkaline reaction led to inquiry into the relation between the alkalinity of the bacterial filtrate and the power of the filtrate to produce hæmolysis. It was found that the filtrates from broth cultures of *B. pyocyaneus* (seven strains, one freshly isolated and quite virulent) produced no greater hæmolysis than NaCl solution, or sterile broth of the same degree of alkalinity. The alkalinity of *B. pyocyaneus* filtrate sometimes reaches as high as 2.6 per cent. normal alkali. If the alkalinity of the *B. pyocyaneus* filtrate be increased or diminished, the hæmolyzing power is correspondingly affected. The hæmolytic power is practically destroyed by neutralization (indicator, phenolphthalein). Most bacterial hæmolysins, like the hæmolysins of blood sera, are inactivated by exposure to a temperature of 56°; but 'pyocyanolysin' will withstand 125° for at least an hour. The statements regarding 'pyocyanolysin' made by Bullock and Hunter, Weingeroff, Breymann and Loew indicate that the hæmolyzing power observed by these writers in the filtrate of *B. pyocyaneus* is no greater than might be due to the simple alkalinity of the medium. It is possible that other strains of *B. pyocyaneus* may be found which produce some other hæmolysin than alkali, but it is evident that in any study of bacterial hæmolysins the superimposition of the effect of alkali upon that of any other hæmolyzing substance must be reckoned with, especially when corpuscles so sensitive to alkali as those of the dog are used for test objects.

A Fat-splitting Torula Yeast Isolated from Canned Butter: L. A. Rogers, Biochemic Laboratory, Washington, D. C.

The author has isolated from several samples of canned butter, a torula yeast, possessing to a limited degree, the ability to split up glycerides with the liberation of free fatty acid. The action of this torula is much weaker than that of the fat-splitting molds.

The acid number of a pure butter fat inoculated with a milk culture of the torula, increased in two weeks from 0.579 to 3.474.

The cells are elliptical, about 3.5 μ long and have little tendency to form chains or bunches.

The yeast ferments maltose slowly at 37° C., but does not ferment lactose, galactose, levulose, mannose or cane sugar.

A complete description will be given in a later paper.

Oligonitrophilic Bacteria of the Soil: Frederick D. Chester, Delaware Agricultural Experiment Station.

Reference is given to the early literature bearing upon the subject of nitrogen assimilation by lichens, aerophilous algæ, molds and bacteria.

Land may gain in nitrogen through the activities of soil bacteria. Oligonitrophilic

bacteria are those that grow in nitrogen-free or nitrogen-poor media, and that possess the power of utilizing the free nitrogen of the air. The oligonitrophiles belong to the *Clostridium* group, or to Beijerinck's *Granulobacter* group.

Clostridium Pasteurianum, which Winogradsky found to possess nitrogen-assimilating properties, is an anaerobe, but it also grows in symbiosis with aerobic forms; it is, therefore microaerophilic. The microaerophiles will grow luxuriantly under normal conditions under diminished oxygen pressure, effected by the active utilization of oxygen by the aerobes (macroaerophiles).

Nitrogen assimilation in the soil is not the result of the activities of a single organism, but of symbiosis of microaerophiles with macroaerophiles. Of the microaerophiles we have *Clostridium Pasteurianum*, several species of *Granulobacter* of Beijerinck, and *Radiobacter* of Beijerinck. Of the macroaerophiles we have *Azotobacter* of Beijerinck.

Azotobacter alone is without nitrogen-assimilating properties, and the same is true of the *Granulobacter* and *Radiobacter*, but mixed cultures of *Azotobacter* with the other forms showed marked gain of nitrogen of four to seven milligrams per gram of assimilated sugar in the medium. A form of *Azotobacter* isolated from Delaware soil was without the power of assimilating atmospheric nitrogen.

The Bacterial Flora of the Oyster's Intestine: Caleb A. Fuller, Brown University.

Of late there has been considerable difference of opinion regarding the significance of *B. coli* in drinking water and various foodstuffs. Some authorities do not consider this organism a certain indication of sewage pollution, while others look with suspicion on all food materials containing bacteria of the colon group. Oysters are especially liable to contamination by sewage, for many cities and towns discharge their waste matters into bays or other bodies of water where they are cultivated.

In some reports on the bacteriology of the oyster it was suggested that *B. coli* might be present normally in the intestines of oysters. This statement differs materially from the results of some previous work of mine on oysters and sewage in Narragansett Bay. These results seem to indicate that this organism does not occur in oysters obtained from perfectly clean sea-water. In order to throw some light on this point I examined the intestines of over two hundred oysters in October and November, 1902. These oysters were taken from a bed known to be free from any trace of sewage. A number of tests have shown that the sea-water above this bed does not contain *B. coli*.

The method of analysis was as follows: Two gelatin plates were inoculated, each with a large loop of material from the intestine of each oyster and grown at room temperature for three or four days. One of these plates was made from the usual nutrient gelatin and the second from gelatin containing carbolic acid (.05 per cent.). From the ordinary gelatin plates I separated sixteen species of bacteria; some of them common water forms, and others unidentified, that seem to be characteristic of the oysters of this locality. Of the carbol-gelatin plates, with but a single exception all remained sterile. The single colony that developed was not *B. coli*. If *B. coli* was present in the intestines of these oysters, even in small numbers, it would have developed in the above medium. Of the other species isolated, none resembled *B. coli* when tested by the usual methods.

From the results of these experiments it appears that the colon bacillus is not normally present in the intestines of oysters, and when present always indicates contamination from some outside source.

The Influence of Physical Conditions on the Character of Colonies on Gelatin Plates: A Preliminary Communication: EDWARD K. DUNHAM, New York University and Bellevue Hospital Medical College, New York.

Attention was called to the influence of physical conditions on the appearance of colonies by two sets of observations: (1) The same species of bacterium grown in different lots of gelatin made with the same ingredients and having the same reaction frequently produced colonies of widely divergent appearances; (2) colonies of different species often form colonies that are indistinguishable in some gelatins, but when grown in other lots of gelatin can be readily recognized as different. These variations were traced to differences in the stiffness of the gelatins, and this led to a study of the physical properties of nutrient gelatin. The melting points, penetrabilities and viscosities were determined and compared with the appearance of colonies on plates made with the gelatins. Attention was chiefly directed to the deep colonies, and the studies were confined to the colon bacillus, bacillus typhosus, bacillus dysenteriæ and a paratyphoid bacillus.

If the gelatin is very stiff the colon colony is lenticular in form and presents a tendency to form multicontours. In a somewhat softer gelatin the colony is spherical, with indications of concentric structure. In still softer gelatin, budding or root-like projections are formed on the surface. In a very soft medium, not a single colony but a federation of colonies, closely grouped together, is produced. Similar variations occur when typhoid colonies develop on plates. These may be small and spherical, or more or less thready with delicate filaments penetrating into the medium, according to whether the gelatin is stiff or relatively soft. In a very soft but still solid gelatin, the typhoid bacilli may penetrate the medium, disseminating themselves throughout its mass. Such plates appear sterile.

Variations in the stiffness of the gelatin may be produced by a reduction of its original stiffness with heat or by incubating the plates at different temperatures. A ten per cent. gelatin made with Compte Fils's or Heinrich's 'Gold Label' gelatin, cooked with an egg for thirty minutes and sterilized three times for fifteen minutes in the Arnold sterilizer, will melt at 29.5° to 30.3° and have a viscosity between eight and nine times that of water. Gelatin plates made with this gelatin and incubated at 27° will yield, *e. g.*, colon and typhoid colonies that can easily be distinguished from each other and fished within twenty-two hours.

In the author's opinion the physical properties of gelatin and temperature of incubation should receive fully as much attention as the ingredients and reaction in the standardization and use of gelatin, particularly when employed for plating with reference to species.

Milk-agar as a Medium for Demonstrating the Production of Proteolytic Enzymes: E. G. HASTINGS, University of Wisconsin.

If ten to twelve per cent. of sterile skim milk is added to ordinary nutrient agar, after the same has been allowed to cool to 50° C. after having been melted, an opaque medium is obtained which, when allowed to solidify in tubes in a sloping position, or poured into Petri dishes, has some advantages over gelatin for the determination of the liquefying properties of bacteria,

inasmuch as it can be incubated at high temperatures.

If cultures of a liquefying organism be made in this medium, the growth after a few hours' incubation will be surrounded by a transparent zone due to the liquefaction of the casein.

Its advantages over gelatin are that it can be incubated at any temperature; that the liquefying power of organisms whose optimum temperature zone lies above 20° C. can be determined in a much shorter time than by the use of gelatin.

It can also be used to determine the presence of proteolytic enzymes in plant and animal tissues by adding cubes of milk-agar to the extracts of such tissues, in the presence of suitable antiseptics, such as small amounts of carbolic acid or formalin. The presence of proteolytic enzymes is made apparent by the edges of the cubes becoming transparent.

Laboratory Notes: W. M. ESTEN, Middletown, Conn.

A new thermo-regulator for incubators heated with incandescent lamps was constructed from a description by Mr. H. E. Ward, of the Illinois Experiment Station. This was shown and its regulating quality demonstrated. Its advantages are that the heat is applied to the interior, and that incubators can be constructed of wood and danger from fire avoided.

New Method of Preparing Blue-litmus-lactose-gelatin.—The cooking and sterilizing of litmus with gelatin proves to be detrimental to the reaction of litmus. The litmus and gelatin media are prepared and sterilized separately, then mixed immediately before plating. Fifteen to twenty per cent. of litmus is digested in distilled water for several hours at 70° C., filtered, the reaction adjusted to + 1.5 per cent., and sterilized. A gelatin medium is prepared with 3 per cent. lactose and 25 per cent. less water than ordinary gelatin. Tubes are filled with 8 c.c. of gelatin.

Cheese-whey-gelatin is prepared by adding rennet to fresh skim milk. The whey is placed in an autoclave for thirty minutes at 105° C. Ten or eleven per cent. of gelatin is added and the medium cooked in open dish until one-fourth is evaporated; the reaction is adjusted to + 1.5 per cent., and tubes filled with 8 c.c.

To prepare the gelatin tubes for plate cultures, place in each tube of melted gelatin with sterile pipette 2 c.c. of the litmus solution, mix and add 1 c.c. of diluted milk, and plate.

The comparative values of the two kinds of gelatin are that the lactose-litmus-gelatin gives the maximum numbers while the cheese-whey-litmus-gelatin gives a strong differentiation of acid and non-acid species. To get the advantages of both kinds of gelatin mixing half and half proves very satisfactory.

It is possible by means of this mixed gelatin to classify the different kinds of bacteria on the plates by means of the colonies alone.

The 'Germicidal Property' of Milk: W. A. STOCKING, JR., Middletown, Conn.

Freudenreich, Park, Hunziker and others have shown that cows' milk, when a few hours old, contains a smaller number of bacteria than when freshly drawn from the cow. From this they conclude that milk possesses a 'germicidal property or action' during the first few hours. This conclusion was based on the results obtained from agar plate cultures, on which the total numbers of bacteria were determined. These investigators, however, were unable to explain the cause of this phenomenon. The purpose of the experiments described in this paper was to determine, if possible, the cause of this dropping out of the organ-

isms during the early part of the ripening period. For this work peptone-litmus-gelatin was used and the milk was plated at intervals of three hours. From these plates the total number of organisms, the number of acid-producing bacteria and the different species, as far as possible, were determined. The results of a long series of experiments seem to show that the decrease in numbers was due, not to any 'property or action' possessed by the milk, but to the natural dropping out of certain species of bacteria which do not find the milk a suitable medium in which to grow.

Fresh milk obtained under ordinary conditions contains a large variety of types and species of bacteria, while milk which has soured or curdled contains but few species, often not more than two or three. Fresh milk ordinarily contains but few of the typical lactic organisms which later cause souring and coagulation. When these species have once gained access to the milk their growth is constant and quite uniform from the first. Certain other acid-producing species, however, and many non-acid species do not find the milk a favorable medium in which to grow, and drop out. Some species appear only in the plates made from the fresh milk, while other species may continue for a few hours and then disappear. Usually the decrease in the numbers of the miscellaneous species is greater than the increase in the 'lactic' species, during the first few hours, so that plate cultures made when the milk is a few hours old will show smaller numbers of bacteria than were found in the fresh milk.

Summary of the Steps which must be Followed in Staining Flagella by Löffler's Method: W. R. COPELAND, Bureau of Filtration, Philadelphia, Pa.

The films of bacteria on the cover slips should be made from suspensions of bacteria obtained by immersing the cells in water for one or two hours in order to dissolve the outside gelatinous capsule.

Löffler's mordant should be made of the best grade of tannic acid with ferrous sulphate and Gruebler's basic fuchsin. This mordant should be heated to 70° or 75° C., until a stream of steam rises for a distance of two inches. The preparation should then be set aside for half a minute. The stain is made of the best grade of aniline oil, absolute alcohol and a saturated alcoholic solution of Gruebler's basic fuchsin. The stain should be applied cold, for from eight to ten seconds.

Finally Löffler's method of staining flagella is better and more powerful than either van Ermengem's, Pitfield's or Löwitz's methods. It magnifies the size of the cells and flagella in a manner that is especially favorable for class demonstration.

Egg Medium for the Cultivation of Tubercle Bacilli: M. DORSET, Biochemic Laboratory, Washington, D. C.

A further report of the results obtained by the use of this medium which had been previously described in *American Medicine,* April 5, 1902, and the 'Eighteenth Annual Report of the Bureau of Animal Industry,' 1901.

Cultures were made from more than seventy-five tuberculous rabbits and guinea-pigs, with almost uniform success, the few failures being traceable to a contamination of the culture tubes or the presence of very small numbers of tubercle bacilli in the tissues from which the cultures were taken. The medium seems to be specially well adapted for obtaining the first growth of tubercle bacilli from animals. Tubercle bacilli of bovine origin gave a slightly less abundant growth than the human tubercle bacilli, and the gross appearances of the cultures differed slightly. The morpho-

logical characters of human and bovine tubercle bacilli when grown on egg have been left for future report.

Studies on Quantitative Variations in Gas Production in the Fermentation Tube: C.-E. A. WINSLOW, Massachusetts Institute of Technology, Boston, Mass.

Experiments were made to determine the amount of variation in gas formation in a series of dextrose broth tubes filled with the same batch of culture medium and inoculated with the same organism. For inoculation, measured portions of an aqueous suspension of the surface agar growth of a strain of *B. coli* were used. A wide variation between individual tubes was observed. Thus in one case with tubes receiving the same amount of culture material the amount of gas varied from 20 per cent. to 62 per cent. of the closed arm after 16 hours, and from 38 per cent. to 86 per cent. after 64 hours. This was not simply a variation in the rapidity of the evolution of gas; for in this instance the maximum of gas formed in a given tube at any time varied from 42 per cent. to 86 per cent. By averaging the results obtained in a number of tubes more general relations became apparent. During the first 12 hours the amount of gas formed depended upon the amount of material used for inoculation, and the relative proportion of hydrogen was greater than at a later period. Between 24 and 48 hours the maximum of gas was generally formed with the classical gas formula of two to one, and after 48 hours a marked decrease of total gas occurred, due to the absorption of carbon dioxide. The principal point brought out was the wide variation in individual tubes due to some unknown factor, and apparently only to be avoided by making a series of duplicate analyses.

Preliminary Note on Chromogenic Cultures of B. diphtheriæ: HIBBERT WINSLOW HILL, Boston Board of Health Laboratory.

Six stock cultures of *B. diphtheriæ*, the originals of which had been isolated between March, 1901, and January, 1902, and since kept on serum, with reinoculation at intervals of one to two months, showed gradually increasing yellow color when streaked on serum.

Recently (December, 1902) this coloration became so striking as to attract definite attention. One of the six cultures (4014) isolated October 18, 1901, from a clinical case of diphtheria, and then typical morphologically and typically virulent to guinea-pigs, was selected for examination. The morphology and virulence, retested in December, 1902, were still typical.

Cultures from this stock developed the color on serum at 37° C., slightly in one day; by the third day the color was very marked—a clear bright yellow. The growth, removed by scraping, is treated with chloroform, which dissolves the pigment. After filtration to remove the bacilli, evaporation to dryness deposits the pigment, which is then found soluble in chloroform and in ether, but not in water. The same culture grown on agar for the same time yields only an ordinary dirty-white tint. When treated similarly, such dirty-white cultures yield a small amount of faint grayish-brown pigment. From fresh uninoculated serum of the same lot ether extracts a yellow pigment, but chloroform does not.

The writer has observed cultures of *B. diphtheriæ* showing a faint pink color, and others which, especially when old, show quite dark-brown or black coloration.

The Chemistry of Bacterial Pigments: M. X. SULLIVAN, Brown University.

While growing bacteria upon synthetic

media, I noticed that often chromogenic varieties became colorless. Accordingly experimenting to determine what salts, bases or acids in addition to the organogens, carbon, hydrogen, oxygen and nitrogen, are necessary for pigment production, I found, with Jordan, that for the formation of fluorescent pigment, sulphates and phosphates are required. Extending the research to other pigments, such as those produced by *B. pyocyaneus, B. prodigiosus, B. ruber balticus, B. rosaceus metalloides, B. janthinus* and *B. violaceus,* I found that the characteristic pigments were produced whenever there were present, in addition to suitable compounds of carbon, hydrogen, oxygen and nitrogen, phosphates together with sulphates, chlorides or nitrates, irrespective of the base. Suitable compounds of C, H, O, N, are asparagin, and the ammonium salts of succinic, lactic and citric acids. The solutions containing asparagin were the best, so that upon a medium consisting of asparagin 0.2 per cent., $MgSO_4$ 0.02 per cent., K_2HPO_4 0.1 per cent., glycerin 2 per cent., the pigments were quickly produced. Magnesium and potassium may be replaced by other bases, as sodium or ammonium. If the glycerin is left out the asparagin must be increased to 1 per cent. to get good pigment formation. Upon media consisting of $(NH_4)_3PO_4$ 0.1 per cent., $(HN_4)_2SO_4$ 0.1 per cent. and glycerin 2 per cent., there occurred a good production of pigment.

Replacing the asparagin and glycerin by ammonium salts of organic acids, 0.2 per cent. to 0.5 per cent., I found that while the succinate, lactate and citrate gave pigment, the tartrate, oxalate, urate and formate, though allowing growth, were unfavorable to chromogenesis.

By testing the chlorides and nitrates as to pigment formation, it was found that upon a solution consisting of asparagin 1 per cent., K_2HPO_4 0.02 per cent., NaCl or KCl 0.2 to 0.5 per cent., or KNO_3 0.02 per cent. the pigment was formed, though less abundantly than when $MgSO_4$ was present. On the other hand the sulphides, bromides and iodides were unfavorable to pigment production.

The conclusions to be drawn are that, in addition to suitable compounds of C, H, O, N, phosphates and sulphates are necessary for the fluorescent pigment, while for the pigments of *B. pyocyaneus, B. prodigiosus, B. rosaceus metalloides, B. ruber balticus, B. janthinus* and *B. violaceus,* the sulphates may be replaced by the chlorides or nitrates.

The Pyocyanin and Fluorescent Functions of Bacteria: M. X. SULLIVAN, Brown University.

Since Gessard's discovery in 1882 of a bacillus which produced a blue or blue-green pigment soluble in chloroform, many experiments have been carried on not only as regards the morphological characters of the bacillus to which Gessard gave the name of *B. pyocyaneus,* but also as to the nature of its pigments. In the study of *B. pyocyaneus,* many varieties have been isolated, so that at present we have kinds which produce pyocyanin alone, others which produce both pyocyanin and a greenish-yellow fluorescent pigment, insoluble in chloroform, but soluble in alcohol and ether, and further, some perhaps degenerate types, which produce a fluorescent pigment only. Now the question is, what is the relation between the different varieties of this bacillus? Are the varieties characterized by the ability to produce a different pigment or pigments, or can the same race be compelled to form different colored products according to the medium on which it is grown? That the latter view is the correct one would seem to be

the conclusion from the following experiments.

A variety which produces pyocyanin only on a medium consisting of asparagin 1 per cent., $MgSO_4$ 0.02 per cent., K_2HPO_4 0.1 per cent., can be made, by gradually increasing the phosphate to 0.5 per cent., to produce both pyocyanin and fluorescent pigment. In this case there is very little pyocyanin and a great deal of the fluorescent pigment. Another variety, which was producing both pyocyanin and the fluorescent pigment, was made to produce the fluorescent pigment alone on asparagin 0.2 per cent., $MgSO_4$ 0.02 per cent., K_2HPO_4 0.5 per cent. This same variety upon asparagin 1 per cent., $MgSO_4$ 0.05 per cent., K_2HPO_4 0.2 per cent., strongly acid, produced pyocyanin alone.

Turning now to the common *B. fluorescens liquefaciens,* which on asparagin 1 per cent., $MgSO_4$ 0.02 per cent., K_2HPO 0.1 per cent., produced the fluorescent pigment. I gradually lessened the phosphate and in another series the sulphate to determine whether or not this bacillus could be induced to take up the pyocyanin function. The fluorescent pigment disappeared and the growth became colorless, but no pyocyanin was produced.

The conclusions to be drawn are that the same variety of *B. pyocyaneus* can be made to produce pyocyanin alone, pyocyanin and a fluorescent pigment, or the fluorescent pigment alone, according to the medium upon which the bacillus is grown; but that the purely fluorescent bacilli can not be made to take up the pyocyanin function.

A Preliminary Chemical Study of Various Tubercle Bacilli: E. A. DE SCHWEINITZ and M. DORSET, Biochemic Laboratory, Washington, D. C.

Dr. de Schweinitz gave, for himself and Dr. Dorset, a brief résumé of the work carried on by the Biochemic Laboratory of the Department of Agriculture so far, upon a chemical examination of the following bacilli: bovine, horse, swine, avian, virulent human and attenuated human. He pointed out that the conclusions which might be drawn from these analyses indicate a closer resemblance in the composition of the germs between the moderately virulent human bacilli and the bovine and swine, than between the moderately virulent human and the very attenuated human bacilli. The analyses also indicate a closer relationship in composition between the attenuated human bacilli and the avian bacilli, than between the two varieties of human bacilli used. He also called attention to the fact that a similar comparative examination of human bacilli and bovine bacilli of various degrees of virulence was being carried out. Attention was called, further, to the fact that the large amount of phosphoric acid obtained from the germs indicated that this constituent was absolutely necessary for the proper development of these bacilli, and it was noted that for a number of years in all the work in the study of tubercle bacilli in the Biochemic Laboratory, culture media had been prepared with the addition of acid potassium phosphate, and that sodium chloride had been entirely eliminated. The results had been uniformly more satisfactory than with any liquid medium that has been used for the tuberculosis bacilli. The importance of a chemical study, not only of the tubercle bacilli themselves, but also of their products, was emphasized.

The authors further presented the history of a case of generalized tuberculosis in a child of five years of age that had been brought up on milk. The cultures obtained from the mesenteric glands of this child had produced generalized tuberculosis in a heifer, after subcutaneous inoculation, within about a month. Drawings which showed the appearance of the lung

from this calf, and also the appearance of the liver of a pig, which had also been submitted to subcutaneous inoculation with this germ, were shown. In addition, drawings showing the comparative results of a subcutaneous inoculation of bovine and human tubercle bacilli in monkeys were presented. These indicated that the bovine tubercle bacilli were very much more virulent for the monkey than the human tuberculosis bacilli used. In the discussion which followed this paper, Dr. de Schweinitz further stated that the cultural characteristics of the germ which had produced the tuberculosis in the heifer upon subcutaneous inoculation appeared to be those which some authors claim to be possessed only by the bacilli derived from the bovine species, and that further, whether the germ that killed the heifer was regarded as a bovine germ or a human germ, the conclusions naturally were of equal value; for if the germ was of bovine origin, then it seemed that tuberculosis in children could be produced by bovine bacilli. If, on the contrary, the germ was what is commonly called the human germ, then it was a germ which was virulent for cattle. He also called attention to the fact that the attenuated human germs used in the chemical study referred to were the offspring of the same attenuated germs which had been used a number of years ago for the purpose of producing immunity to tuberculosis in small animals, by subcutaneous inoculation. These results were published at the time, in the *Medical News*, December, 1894.

Reference was also made to the fact that tuberculin prepared from bovine bacilli, and tuberculin prepared from the virulent or attenuated human bacilli, when tested interchangeably on men and animals, seemed to give the same positive results. A résumé of these tuberculin tests was published in *American Medicine*, in January, 1902.

Further Evidence of the Apparent Identity of B. coli and Certain Lactic Acid Bacteria: S. C. Prescott, Massachusetts Institute of Technology, Boston, Mass.

Last year it was reported by the author that certain lactic acid bacteria isolated from grains and products of milling gave all the cultural reactions generally regarded as typical of *B. coli*. In the present work cultures of 'lactic acid bacteria' were isolated from various sources apparently free from contamination with fæcal matter, and were compared directly with 23 cultures of *B. coli* obtained either directly from fæces or from waters known to be sewage-polluted. Of these 61 cultures, 44 gave exactly the same reactions in the culture tubes, 25 of them being lactic acid bacteria, and 19 typical colon bacilli. These organisms were also found to be alike in their morphological characters.

A study of the fermentative power showed that the 'lactic acid bacteria' and 'colon bacilli' produced approximately the same amount of acid when grown under similar conditions, while organisms of different groups, as for example streptococci, gave results showing a marked difference in fermenting power.

As a final test the effect of inoculation into animals was noted, with the result that lactic acid bacteria and colon bacilli produced the same results when used in the same manner and with like amounts. Subcutaneous injection of 1 c.c. produced dullness and torpor, followed by rise of temperature, while intraperitoneal inoculation of 1.5 c.c. produced death within twenty-four hours.

As a result of the experiments the author believes that the organisms studied are not merely alike in certain characteristics, but are absolutely identical, and thus that or-

ganisms having the same characteristics as *B. coli* are very widely distributed in nature, and their presence, unless in considerable numbers, is not necessarily indicative of recent fæcal contamination.

On the Relative Viability of B. coli and B. typhosus under Certain Conditions: STEPHEN DEM. GAGE, Lawrence Experiment Station.

In various studies of both *B. coli* and *B. typhosus* at the Lawrence Experiment Station, a number of points of similarity in the behavior of the two species under certain conditions have been noted, which appear to have a bearing on the interpretation of tests for *B. coli*.

1. As regards sand filtration. With a water to which both species have been added, 99.9 per cent. of all the *B. coli* and 100 per cent. of the *B. typhosus* were removed by an intermittent filter, and 99.8 per cent. of *B. coli* and 99.9 per cent. of *B. typhosus* by a continuous filter.

2. As regards the persistence of the two organisms in a filter after infection of the applied water has ceased, *B. coli* was found to continue in the effluent from the intermittent filter for 24 to 36 hours, and *B. typhosus* only for two to three hours.

With the continuous filter *B. coli* continued for four to six days and *B. typhosus* for two days.

3. Effect of cold without freezing. In a water subjected to a temperature of 33° F., about 90 to 95 per cent. of both species were destroyed in 24 hours; a few organisms of each, however, may live for a considerable number of days.

4. Elimination by freezing and viability in ice. About 50 per cent. of the *B. coli* and 75 per cent. of the *B. typhosus* were destroyed by fifteen minutes' freezing; after one hour, 95 per cent. of the *B. coli* and 98 per cent. of *B. typhosus* were killed; and at the end of 24 hours over 99 per cent. of all the organisms had disappeared. Of the few organisms surviving, however, *B. coli* were found alive after three months, and *B. typhosus* after nine months, in the frozen condition, these experiments being still in progress at the present writing.

5. Resistance to heat. Both species resist temperatures up to 45° C. for five minutes. At between 45° and 55° C. all but a few individuals of each are destroyed, these few individuals, however, resisting temperatures up to 85° C. at which temperature all the organisms of both species were destroyed.

The effect of sunlight and the relative viability of both species in both sterile and natural waters are being studied, and from the data at hand a similarity between the two species will also appear.

The Germicidal Properties of Glycerine in Relation to Vaccine Virus: M. J. ROSENAU, Hygienic Laboratory, Washington, D. C.

The bacteriological examination of many dry points and capillary tubes of glycerinated virus bought upon the open market showed an excessive contamination, due to an over-confidence in the germicidal properties of glycerine. About one year ago, of 41 dry points examined, there was found an average of 4,807 organisms per point; of 51 glycerinated tubes examined, there was an average of 2,865 colonies per tube, some individual tubes running as high as 18,000. Following a publication of these facts and the warning given to manufacturers that glycerine is not a substitute for care, a great improvement in the bacteriological contents of glycerinated virus on the market resulted. Thus, of 89 tubes examined an average of only 28 organisms per capillary tube was found as a result of recent studies.

Glycerine has distinct antiseptic powers. It restrains the growth of most bacteria in dilutions of 35 per cent.; molds grow on the surface of bouillon containing 48 per cent.; no growth was observed above 50 per cent. Its germicidal properties are very feeble. It has practically no effect on spores, anthrax and tetanus being the spores tested. Tetanus, however, does not multiply in glycerinated lymph, nor in bouillon containing 60 per cent. of glycerine, the amount used by manufacturers in glycerinated virus.

It was found that the antiseptic and germicidal powers of glycerine varied somewhat with the kind of glycerine used, and also with the organisms tested. Cholera and plague were retarded by the presence of 21 per cent. to 24 per cent., while pus cocci grew in 31 per cent. and some molds grew on the surface in 48 per cent. Pus cocci are usually rendered sterile in 50 per cent. glycerine within five days, though they were kept alive as long as ten days in the ice-chest; they died more quickly at incubator temperature. In 80 per cent. and 90 per cent. glycerine Staphylococcus pyogenes aureus was kept alive in the ice-chest at 12° C., 41 days. Anthrax spores have been kept alive 247 days and the experiments are still going on. Tetanus spores were found viable in various percentages of glycerine after 135 days in the ice-chest.

The Reaction of Certain Water Bacteria with Dysentery-Immune Serum: D. H. BERGEY, University of Pennsylvania, Philadelphia.

A Mold Pathogenic to Lobsters: F. P. GORHAM, Brown University.

Complete Inhibition of the Cholera-Red Reaction by Impure Peptone. JAMES CARROLL, Army Medical Museum.

Demonstration of the Value of MacConkey's Medium for the Differentiation of B. coli from B. typhosus: N. MACL. HARRIS, Johns Hopkins University.

EDWIN O. JORDAN,
Secretary.

SCIENTIFIC BOOKS.

Ueber verschiedene Wege phylogenetischer Entwickelung. By O. JAEKEL. Jena, Gustav Fischer. 1902. 8vo. Pp. 60; 28 text-figures.

Der Neo-Lamarckismus und seine Beziehungen zum Darwinismus. By R. VON WETTSTEIN. Jena, Gustav Fischer. 1903. 8vo. Pp. 30.

The intensity which a few years ago characterized the struggle between the opposing camps of Neo-Lamarckism and Neo-Darwinism has, fortunately, largely subsided. Some new standpoints have arisen, notably those afforded by the doctrine of organic selection and by the rediscovery of the Mendelian law, and there has been a general tendency to inquire more thoroughly into the laws of variation and to seek for the factors concerned in that phenomenon.

The first of the two pamphlets which form the subject of this notice represents a phase of this tendency, and is of interest as exhibiting the views of a paleontologist who has had access to and has made admirable use of an exceptional abundance of material bearing upon the questions he discusses. In his opening pages Professor Jaekel combats the idea that if the paleontological record were complete it would furnish evidence of almost insensible transition from species to species, so that no 'good' species could exist for the paleontologist, and points out that an exhaustive search for confirmation of this idea, extending through the last three decades, has brought to light only three more or less acceptable cases, namely, those of the Steinheim *Planorbis* and of the Pannonian and Kossian *Paludinas,* none of which shows any more gradation than may be found in variable species of recent land snails.

The conclusion is reached, accordingly, that the distinctness of species was just as pronounced in the past as it is to-day, and that the idea of species has a definite morphological value. But this distinctness can not have been brought about by successive and promiscuous minglings of the germ plasm, by amphimixis; the rôle of this has rather been to annul in the course of generations extreme variations, and, granting the limitation of amphimixis to a group of forms by the action of migration, isolation or some other such factor, the result will have been the consolidation or concentration of certain characters, determined by the environment, and the formation of a species. A species, then, is 'a product of individual variation and limitation of crossing, and represents a local departure from the general tendency of development'; it is a fixation of one of the rapidly changing pictures produced during a general developmental progress.

What then are the factors which determine the general developmental tendency? Of these Professor Jaekel discusses three, namely, orthogenesis, epistasis and metagenesis, none of which is entirely unfamiliar, although the last two may not be recognizable under their new names. The factor of orthogenesis is essentially the orthogenesis of Eimer and the 'Vervollkommnungstrieb' of Nägeli, extended, however, so as to include progressive modifications of parts as well as of the entire organism, and to embrace as well retrogressive as progressive modification. As examples of its action there are cited the progressive modifications in the structure of the arms in the Melocrinidæ and Taxocrinidæ, the gradual migration of the anus in the Caryocrinidæ from the lower region of the theca to its upper margin, and the progressive complication of the septal lines in the Ammonitidæ.

Epistasis is a modified form of the process emphasized by Boas under the name of neotenia, a reversion of a phylum to a modified embryonic condition. Evidence for such a factor is found again among the crinoids, in the apparently reversionary peculiarities observable in certain groups, and also in the Saleniidæ and in the Agnostidæ among the trilobites, whose small number of free body segments is regarded as due to an inhibition of development, rather than as an ancestral character. So too the transition of the Acanthodidæ of the Devonian period, with numerous dermal bones on the head and shoulder girdle and with acrodont teeth, to their Permian descendents which some paleontologists have regarded as true selachians, is advanced as a case much to the point, and the discovery of two Paleozoic cyclostomes which show, when compared with the more ancient *Palæospondylus*, a marked diminution of osseous material in the skeleton, leads to the supposition that this group of fishes may also have arisen as the result of epistasis. It must be confessed, however, that the morphologist who may have followed Professor Jaekel up to this point with interest, if not with absolute confidence, will draw a deep breath when he reads that the author is inclined to regard the entire group of the fishes as degenerated vertebrates, whose watery environment inhibited their normal development 'und die Formen namentlich in ihrer Atmung zur Stadien zurückführte, wie wir sie bei Crustaceen antreffen.'

Finally, under the factor of metakinesis there are found the results of what embryologists term cenogenetic modification, for the process is defined as a profound modification of a form in a manner impossible in the adult and only possible in a young stage in which the various organs are not yet histologically specialized and still possess more or less plasticity. Examples of the action of this force are again drawn from the crinoids, but these can not, within due limits, be detailed here. Among the echinoids the development of the irregular forms from the regular is regarded as the result of metakinesis, and the occurrence in the Trias of *Tiarechinus,* with more than two rows of interradial plates, is quoted among other examples of its action.

Such, in brief, are the ideas which Professor Jaekel advances in his pamphlet, which, it may be said, is a reprint from the 'Verhandlungen des V. Internationalen Zoologen-Congresses.' The ideas are not entirely novel, nor does their exposition free the mind of a

sense of something yet lacking for the complete solution of the question. It is not clear why epistasis and metakinesis may not well be regarded as particular cases of orthogenesis as Professor Jaekel defines that factor, and, if amphimixis have no place or part in the production of the orthogenetic progress, what is its source and maintenance? The paper, however, is full of interest, the ideas being clearly and forcibly expressed, and accompanied by a wealth of illustration drawn from sources unfamiliar to the majority of biologists.

The second paper, that of Professor von Wettstein, is a relapse into the old discussion, since it takes as its thesis the combined action of the Darwinian and Lamarckian factors in the origin of species. It can not be said, however, that the evidence adduced by the author from the botanical field in favor of Lamarckianism is more apt to carry conviction to the minds of Selectionists than much that has already been presented. The fact, for instance, that an asporogenous variety of yeast, produced by exposure to an abnormally high temperature, does not again become sporogenous when grown at a normal temperature, will not be regarded by Selectionists as proof of the Lamarckian position, since they recognize the inheritance of acquired characters, if so they may be called, in unicellular organisms. Nor will the gradual assumption of the peculiarities of Hungarian wheats by foreign varieties grown in that country prove to them a stumbling-block, since such changes may plausibly be explained as the results of the direct action of the environment upon the germ plasm and through it upon the somatic cells. The author, in fact, fails to take into account the fundamental idea of the Selectionist standpoint, namely, the isolation of the germ plasm, and, like many of his predecessors, assigns to the term 'acquired characters' a meaning very different from that which it possesses for a Selectionist.

J. P. McM.

Municipal Engineering and Sanitation. By M. N. Baker. New York, The Macmillan Company. 1902. 12mo. Pp. 317. $1.25. In the Citizen's Library.

The phenomenal growth of cities which has been so characteristic a feature of the last two decades has brought us face to face with many new and important problems. It sometimes seems as if these problems were increasing faster than the abilities of our cities to solve them; but to students of sociology it is an encouraging sign of the times to note the interest which is being rapidly awakened in municipal affairs among local organizations such as boards of trade, village improvement societies, women's clubs, as well as among individuals. It leads one to hope that in the not distant future the '*age of the politician*' may be succeeded by the *age of the good citizen*. To all who are interested in municipal affairs, especially in those matters which relate to the control of the forces of nature, Mr. Baker's book on 'Municipal Engineering and Sanitation' can be heartily recommended. It is a review of the whole field, and touches the vital points of many classes of activity. It describes the underlying principles of all, but does not pretend to give detailed information about any one. The subjects treated are grouped under five heads, as follows: 'Ways and Means of Communication'; 'Municipal Supplies'; 'Collection and Disposal of Wastes'; 'Protection of Life, Health and Property'; 'Administration, Finance and Public Policy.' The forty-three chapters of the book relate to streets and pavements, bridges, ferries, docks, telephones; water, ice, milk, markets, lighting and heating; sewerage, street-cleaning, garbage disposal, cemeteries; fire protection, smoke abatement, public baths, dwellings, parks; city charters, contracts, franchises, municipal ownership, taxation, uniform statistics, etc. These subjects are treated concisely, and a hasty reading of the book might lead one to think that they were treated too concisely, that the book was, in fact, a mere explanatory catalogue of unsolved municipal problems. This opinion would be far from the truth. Embellishments of rhetoric and extended illustrations are not to be found, but all the essential facts are there and where no facts are obtainable no attempt is made to conceal it by indulging in generalities. The book

is to be commended almost as much for what it omits as for what it includes. It shows evidence of accurate knowledge and careful preparation, as might be expected from the pen of the associate editor of the *Engineering News*. Several chapters were written by the author's wife, Mrs. Ella Babbitt Baker, and these are among the most interesting in the book. The book gives comparatively few references, a fault for which the author atones by referring to Robert C. Brook's 'Bibliography of Municipal Problems and City Conditions' (New York, 1901).

A comparison of the title of the book with its table of contents shows to what wide limits the scope of the 'engineer' has extended. 'Municipal housekeeping' is a term which has been applied not inappropriately to certain groups of activities, but 'municipal engineering' is much nearer the truth. Whenever forces are to be controlled and materials handled on a large scale, there the engineer is to the fore. So in our growing cities activities that once were domestic or individual have become engineering in their nature and must be entrusted to technical men. The author well says: 'Happily the day is coming when permanent and well-paid technical men will be put in charge of all technical work, and the most experienced specialists of the country will be called in to aid in the construction and testing of all public works and to advise from time to time regarding the best mode of operation.'

American Municipal Progress—Chapters in Municipal Sociology. By CHARLES ZUEBLIN. New York, The Macmillan Company. 1902. 12mo. Pp. 380. $1.25. In the Citizen's Library.

The author begins his introductory chapter in the good old German way by defining his terms. He draws a distinction between the 'urban district,' 'city' and 'municipality'; the first having 'a psychological and industrial unity,' the second, 'a legal and topographical unity,' and the third 'a functional unity.' He considers the municipality as the organization for supplying communal needs, and defines 'municipal sociology' as the science which 'investigates the means of satisfying communal wants through public activity.' Illustrations of these definitions then follow.

The work is divided into chapters which treat respectively of 'Municipal Sociology'; 'Transportation'; 'Public Works'; 'Sanitation'; 'Schools'; 'Libraries'; 'Public Buildings'; 'Parks'; 'Public Recreation'; 'Public Control, Ownership and Operation.' It is written in a discursive style, and the principles set forth are sometimes obscured by an overabundance of illustration. It is in these illustrations, however, that the work is chiefly valuable. The author, who is professor of sociology in the University of Chicago, evidently has at hand an extensive collection of data from the chief cities of America upon all phases of municipal work, and the comparisons which he makes between the different cities are most instructive. It is interesting to observe the different directions in which engineering effort has been bent in different cities. One city, for example, excels in its parks, another in its streets, another in its schools, another in its water supply, etc. The book gives the impression of being written by one who has studied the work of others rather than by one who has taken part in it himself. It is somewhat inclined to be theoretical rather than practical. For instance, the author still clings to the idea that the cost of sewage disposal may be met by separating the solid matter 'through familiar processes' and selling it as a fertilizing material, while sanitary engineers agree that this is, at present at least, impractical. The last chapter, on 'Political Control, Ownership and Operation,' is perhaps the most valuable one in the book. It shows the modern tendency towards public absorption of municipal functions, an evolution towards socialism which the author manifestly approves. The work concludes with numerous appendices giving interesting statistics for various American cities, and digests of laws affecting schools, child labor, etc. G. C. WHIPPLE.

A Text-book of Quantitative Chemical Analysis. By FRANK JULIAN. St. Paul, Minn., The Ramsey Publishing Company. 1902. 8vo. Pp. 604. Illustrated. $6.00.

This voluminous work is from the brain and pen, not of a teacher, but of the chief chemist in the Great Northern Railway Shops, St. Paul, and naturally reflects the practical experience of its industrious author. To attempt to review in a conscientious manner a closely printed volume of more than six hundred pages, estimated to contain over four hundred thousand words, is impossible in the time and space that can be given. The author states that the 'volume is intended for the aid of students who have a fair acquaintance with the elements of general chemistry and can devote a limited time to quantitative analysis concurrent with or following the usual qualitative course.' At the same time it will form 'an introduction to the monographs on special departments of technical analysis for those purposing to engage in some particular branch as a future occupation.'

After outlining the general principles of the subject and describing the operations usually employed, the book presents a graded series of exercises for practice; these comprise twenty-four examples of great diversity, alcohol, ferrous sulfate, coffee, cast iron, ether, vinegar, hydrastis, metol, steel, barium chloride, lard, air and wollastonite, with others, in the sequence here given.

Then Part III. begins, at page 259, and deals with the analytical behavior of articles of commercial importance; these embrace, among others, iron ores, coal, natural water, fertilizers, alkaloids, tannins, carbohydrates, soap, milk and butter, and urine, besides methods based on colorimetry, electrolysis, and organic analysis both proximate and ultimate.

Part IV., beginning at page 521, gives notes and observations relating to the art in general. The volume closes with an appendix on 'Technical and Industrial Analysis,' and an index.

This work is in some degree encyclopedic; the author shows familiarity with many branches of the subject, and the numerous citations show a wide knowledge of the literature, especially American. He has rescued from the pages of periodicals many good methods little used in laboratories, giving their authors due credit. He shows throughout ability, thoughtfulness and universality. The arrangement of some of the matter is open to criticism. The book adopts the modern spelling of 'sulfur'; it is freely illustrated; its rather small type was probably necessitated by its length; there are about seven hundred words on each page. The paper, type and binding are hardly up to the high standard adopted for other works of like character.

This comprehensive treatise of Mr. Julian contains many processes, as well as specific details of ordinary methods, not easily found elsewhere, and ought to be serviceable in the libraries of technical schools and universities as a work of reference. H. C. B.

SCIENTIFIC JOURNALS AND ARTICLES.

BIOLOGICAL BULLETIN.

VOLUME IV., No. 1, December, 1902:

1. G. T. Hargitt, 'Notes on the Regeneration of *Gonionema*.'

A résumé of experiments conducted at the Marine Biological Laboratory, Woods Holl, during the summer of 1901, and extending the previous work of C. W. Hargitt and Morgan.

2. C. W. Hargitt, 'Notes on a few Medusæ new to Woods Holl.'

This paper is part of the synopsis of the medusoid fauna of the region which it is hoped may be ready within the year.

3. Walter S. Sutton, 'On the Morphology of the Chromosome Group in *Brachystola magna*.'

The conclusion is that the association of paternal and maternal chromosomes in pairs and their subsequent separation during the reducing division may constitute the physical basis of the Mendelian law of heredity. This subject will be continued in a later number of the *Bulletin*.

4. Ida H. Hyde, 'The Nervous System in *Gonionema Murbachii*.'

A study of the distribution of the nervous system with reference to its physiology.

VOLUME IV., No. 2, January, 1903:

1. Harold Heath, 'The Habits of California Termites.'

2. J. H. Elliot, 'A Preliminary Note on the Occurrence of a *Filaria* in the Crow.'

Records the discovery of embryo filariæ in the blood and of *Halderidium* in the red corpuscles.

3. Mary J. Ross, 'The Origin and Development of the Gastric Glands of *Desmognathus, Amblystoma* and Pig.'

This work was submitted to the Faculty of Cornell University for the degree of Doctor of Philosophy.

4. H. F. Thatcher, 'A Preliminary Note on the Absorption of the Hydranths of Hydroid Polyps.'

The conclusion is reached that the process is not liquefaction of protoplasm, or of withdrawal of the polyp as a whole. The absorption takes place by the degenerating cells of the endoderm and ectoderm being turned into the digestive tract of the colony.

VOLUME IV., No. 3, February, 1903:

1. Axel Leonard Melander, 'Notes on the Structure and Development of *Embia texana*.'

2. W. R. Coe and B. W. Kunkel, 'A New Species of Nemertean (*Cerebratulus melanops*) from the Gulf of St. Lawrence.'

3. R. P. Cowles, 'Notes on the Rearing of the Larvæ of *Polygordius appendiculatus* and on the Occurrence of the Adult on the Atlantic Coast of America.'

The rearing of the larvæ of an American *Polygordius* by the diatom method, and its identification with the European species *appendiculatus*.

4. Arthur W. Greeley, 'On the Effect of Variation in the Temperature upon the Process of Artificial Parthenogenesis.'

The length of exposure to the solution necessary to produce artificial parthenogenesis of the unfertilized eggs of *Asterias* and *Arbacia* varies inversely with the temperature. An increase of temperature to 27° C. liquefies the protoplasm of the *Asterias* eggs and produces a fragmentation of the nucleus.

5. Wm. Morton Wheeler, '*Erebomyrma;* a new genus of Hypogæic Ants from Texas.'

Containing an account of the first ant-genus to be established by an American.

Science Abstracts will in future be published in two sections, *Section A:* physics embracing light, including photography; heat; sound; electricity and magnetism; chemical physical and electro-chemistry; general physics; meteorology and terrestrial physics; physical astronomy. *Section B:* embracing steam plant, gas and oil engines; automobiles; oil-engine-driven ships and launches; balloons and airships; general electrical engineering, including industrial electro-chemistry; electric generators, motors and transformers; electrical distribution, traction and lighting; telegraphy and telephony. The American Physical Society is now joined with the Institution of Electrical Engineers and the Physical Society of London in the direction of the publication and has elected Professor E. H. Hall of Harvard University as its representative on the publishing committee. In consequence of this arrangement, Section A will in future be received by all members of the American Physical Society. The American Institute of Electrical Engineers is also cooperating with the committee and taking special means to bring the publication to the notice of all its members, who will in future be able to obtain it at a reduced subscription rate through the secretary of the American Institute.

SOCIETIES AND ACADEMIES.

THE NEW YORK ACADEMY OF SCIENCES. SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

AT the meeting of the section on January 5, the following papers were presented: Mr. C. C. Trowbridge on 'Some Facts Regarding Persistent Meteor Trails—the significance of size, color and drift'; Professor Harold Jacoby on a 'Comparison of Astronomic Photographic Measures With the Reseau and Without it.'

At the meeting of February 2, Mr. Herschel C. Parker read a paper on 'Experiments Concerning Very Brief Electrical Contacts,' exhibiting contact keys by means of which he could get a fairly accurate range of adjustment from 0.1 second to 0.00001 second.

Professor Marston T. Bogert gave a very interesting talk on 'Some Products Derived from Coal,' paying special reference to the products from coal-tar. From bituminous coal, by distillation, are derived: (1) Coal gas, (2) ammonia water, (3) tar and (4) coke.

The uses of coal-gas and coke are so well known as to need no mentioning. In the United States, the total production of ammonium compounds for the year 1900 amounted to 2,700 tons, valued at about $2,000,000.

The chief source of coal-tar is the coal-gas manufacture, but large amounts are also obtained from the by-product coke ovens, the water-gas industry, etc. During the year 1900, twenty per cent. of the gas produced in the United States was coal-gas, requiring the distillation of 1,350,000 tons of coal, and producing thirteen and one half billion cubic feet of gas, *i. e.,* 10,000 cubic feet per ton of coal. The yield of tar is approximately five per cent. of the weight of the coal used; the product of tar was, therefore, 67,000 tons. If we add to this the 52,000 tons of tar from the by-product coke ovens, we have a total of about 120,000 tons of tar produced in 1900 from coal. This is less than one fifth of the amount produced in England from similar sources. The total production of coal-tar in Europe for the year 1898 was 1,120,000 tons.

Coal tar is first roughly divided into the following fractions: (1) First runnings, or light oil (lighter than water); (2) middle oil, or carbolic oil; (3) heavy oil, dead oil, or creosote oil; (4) anthracene oil, or green grease; (5) pitch (remains in the stills).

These five products were taken up in detail, and about one hundred drugs, perfumes, etc., were exhibited, the method of derivation of the substances being explained.

S. A. MITCHELL,
Secretary of Section.

BIOLOGICAL SOCIETY OF WASHINGTON.

THE 366th meeting was held Saturday, February 7.

Vernon Bailey spoke on 'The Goodnight Herd of Buffaloes and Cataloes in Texas,' saying that this comprised fifty buffaloes and about seventy cataloes, or crosses between the buffalo and domesticated cattle. The breed selected for crossing was the Polled Angus, and the half-bloods resembled these more than they did the buffalo, being black, of the same build, and often hornless. This cross has most excellent beef qualities, growing rapidly and reaching a weight of 1,800 pounds, while it is unusually hardy. Mr. Goodnight hopes to establish a fixed breed of this grade. So far all crosses have been between buffalo bulls and Polled Angus cows, the demand for buffaloes being such that the buffalo cows have been kept breeding pure-blooded calves.

T. H. Kearney presented a paper entitled 'Further Observations on the Effect of Sodium and Magnesium Salts, with and without Calcium, upon Seedlings.'

In experiments upon seedlings of the white lupine (*Lupinus albus*) it was found that the degree of toxicity of certain salts of sodium and magnesium was greatly affected by the presence or absence of calcium. In pure solution magnesium sulphate was found to be far the most toxic, and sodium bicarbonate the least. In solutions to which an excess of calcium sulphate had been added the order of toxicity was quite different, sodium carbonate being toxic in slightest concentration, while magnesium sulphate became decidedly the least toxic. In pure solution a 0.00125 normal solution of magnesium sulphate represents the maximum concentration permitting the root tips of lupine seedlings to retain their vitality during a twenty-four-hours culture. Upon the addition of an excess of calcium sulphate, however, the root tips could survive in a normal 0.6 solution of the magnesium salt.

The question whether other higher plants, under exactly similar conditions of experiment, would show a corresponding relation to the same salts, immediately presented itself. With lucerne or alfalfa (*Medicago sativa*) almost identical results were obtained, the salts proving toxic in the same order and almost in the same degree, both in pure solutions and in solutions to which calcium sulphate was added.

As it was desirable to ascertain the effects of these salts on plants of widely different relationships, the experiments were repeated on maize, the criterion of toxic effect being the death point of the strongest rootlet. Very unexpected results were obtained, for with pure solutions both the relative and the absolute toxicity of the salts were found to be widely different from those observed in the case of the lupine. In pure solution the salt which killed at the lowest concentration was sodium carbonate, while the least toxic of all was

magnesium sulphate. With the latter salt the root tip retained its vitality in a normal 0.25 solution, hence at a concentration of the pure solution two hundred times as great as the maximum which allowed lupine root tips to survive. Equally interesting results were obtained upon adding calcium sulphate to the solutions.

It is important, in view of the diverse results obtained, to continue the experiments with many different plants. Until that is done no generalizations are possible, and we may only say that the protoplasm of remotely related plants differs widely in its reaction to pure solutions of various mineral salts; while the addition of a calcium salt would appear to cause a certain amount of uniformity in the effect of each salt upon various organisms.

Frank Bond discussed 'Irrigation Methods and Machinery,' illustrating his remarks with lantern slides showing how the conditions varied in different states and the different types of dams, reservoirs, canals and devices for measuring the amount of water used. He concluded with some remarks on the great Assouam dam on the upper Nile.

F. A. LUCAS.

GEOLOGICAL SOCIETY OF WASHINGTON.

AT the 138th meeting of the society, held in the assembly hall of the Cosmos Club, Wednesday evening, February 11, 1903, the following program was presented.

Mr. W. C. Mendenhall, 'Chitina Copper Deposits, Alaska.'

The Chitina copper belt is in the eastern part of the Copper River basin, Alaska.

The deposits which have been exploited here are concentrations in various forms of copper, which is believed to have been distributed originally in minute quantities throughout an extensive series of basalt flows of pre-Permian age. The most promising ore bodies are found near the contact with a heavy limestone which overlies the basalts. They occur as veins in the limestone and in the greenstone or as 'bunches' in the greenstone only. The ores are usually bornite or chalcocite in the surface exposures. Chalcopyrite and native copper also occur.

Mr. David White, 'An Anthracite Coal Field Three and a half Hours West of Washington.'

Under this title the speaker contributed some observations on the Sleepy Creek mountain basin in Morgan County, West Virginia. It has recently been thought by some geologists that the coal-bearing series here might be of Pottsville age, but the stratigraphic and paleontologic evidence were stated by Mr. White to agree in indicating that the beds belong to the Pocono.

One very thick, though highly impure, coal has been exposed at a number of localities. Its anthracitic character is ascribed to the porosity of its rock environment and the alterative influences to which it has been subjected because of its extreme eastern position. This position perhaps accounts also for its exceptional thickness.

Mr. George W. Stose, 'The Structure of a Part of South Mountain, Pennsylvania.'

South Mountain, the Blue Ridge of southern Pennsylvania, is composed of Lower Cambrian quartzites and shales forming a flat-topped, steep-sided anticline exposing Algonkian volcanics in the center. The quartzites dip steeply beneath the limestone of the Cumberland valley and only small local faults, if any, occur along the western flank of the mountain.

Offsets of the mountain front are due to additional anticlines coming in on the northwest and plunging southwestward beneath the limestone, which partakes of the folding of the mountain rocks. The offset opposite Waynesboro is accentuated by faulting.

Mr. Geo. Otis Smith, 'Abandoned Stream Gaps in Northern Washington.'

The cases cited are in the Okanogan valley, and, as shown by photograph and contoured map, are peculiar topographic features, but very common in this region. Such series of gaps on the valley side result from the successive occupation by streams flowing along the side of an expanding valley glacier. Antoine Coulee, near the junction of the Methow and Columbia Rivers has been described by Professor Russell as the fissure behind a displaced block. Glacial and physiographic evidence

was cited, however, to show that this larger gorge was also the product of stream erosion at a time when the Columbia cañon was occupied by the Okanogan glacier with a thickness of ice exceeding 2,500 feet.

W. C. MENDENHALL,
Secretary.

THE RESEARCH CLUB OF THE UNIVERSITY OF MICHIGAN.

THE club met on the evening of January 21, and listened to a paper by Dr. C. L. Meader on 'The Acquired Meanings of the Latin Pronoun Idem,' and a paper by Professor H. S. Carhart on 'The Rôle of Thermoelectromotive Forces in a Voltaic Cell.'

The latter contained in brief the thermodynamic theory of a voltaic cell, so far as relates to its properties dependent on temperature. It was shown that all these could be completely explained by means of electrolytic thermoelectromotive forces between a metal and the liquid in contact with it. Thermoelectromotive forces exist without temperature difference at the junctions, for a current will either absorb or generate heat at a junction according to its direction in relation to that of the thermo-electromotive force there.

Data were given showing that the temperature coefficients of a Daniell cell, a Carhart-Clark cell, and a calomel cell are all accounted for numerically by the thermoelectromotive forces at the metal-liquid junctions.

It was also shown that the heat represented by the second term of the Gibbs-Helmholtz equation is the difference between the heat generated at the negative electrode, where the current flows against the thermoelectromotive force, and that absorbed at the positive, where both current and electromotive force are in the same direction. The effects are thus localized in the cell.

It was also demonstrated by curves and numerical data that the electromotive force of a concentration cell is explained for dilute solutions by the thermo-electromotive forces at the two electrodes, because this electromotive force increases with the density of the solution. For this last reason also thermoelectromotive forces explain the change in the electromotive force of a Daniell cell when the density of either solution is changed. All these conclusions have been confirmed by numerous measurements.

FREDERICK C. NEWCOMBE,
Secretary.

ELISHA MITCHELL SCIENTIFIC SOCIETY.

THE 146th meeting was held in the Chemical Lecture Room, University of North Carolina, February 10, at 7:30 P.M.

In a paper on 'The Biological Blood Test,' Dr. R. H. Whitehead gave an account of the recent work of Uhlenhuth in the serum-diagnosis of blood in various species of animals, and called attention to its great importance in certain medico-legal cases.

Under the title 'Recent Work on Corals,' Dr. J. E. Duerden gave an account of his work upon the septal development in recent and fossil corals. In recent corals the septa beyond the primary septa—metasepta—are found to appear bilaterally, in a dorso-ventral sequence, within each of the six primary systems, the adult radial symmetry being secondary. In certain Palæozoic corals the metasepta arise in a regular dorso-ventral succession within only four of the six primary systems.

'The Peter Cooper Hewitt Static Transformer' was described by Professor J. W. Gore.

CHAS. BASKERVILLE,
Secretary.

COLORADO ACADEMY OF SCIENCE.

THE 31st, 32d and 33d meetings of the Colorado Academy of Science were held in the rooms of the State Historical and Natural History Society of Colorado, in the Capitol building, Denver, Colorado, October 21, November 18 and December 16, 1902. The membership of the academy is restricted to those members of the State Historical and Natural History Society of Colorado engaged in scientific work and investigation. These sessions of the academy have had an attendance ranging from about 100 to 300, and the outlook for the winter meetings is most encouraging.

At the 31st meeting the death of Professor A. M. Collett was announced, and Mrs. Cornelia S. Miles, first vice-president, became acting president. Mrs. Miles is principal of the Broadway School, Denver, Colorado, and has received the degree of A.M. in the graduate school of the University of Denver, and last summer was engaged in scientific work in the graduate school of the University of Chicago.

Professor George L. Cannon, who for a number of years had been engaged with Professor Collett in scientific work in the East Denver High School, gave a sketch of his life, and offered resolutions which were adopted.

Mr. E. B. Sterling delivered a lecture on 'puff balls,' obtained in Denver and vicinity, explaining the difference between them and the eastern forms. He pronounced the several species at Denver, so far as tested by his observations and experience, to be edible. His lecture was supplemented by a short address by Professor Ellsworth Bethel, a recognized authority on botany in Colorado. Professor George L. Cannon followed with an address on the 'Death of the Leaves,' contrasting the fall colors of this region with those of the East.

At the 32d meeting, 'Navajo Blankets, their History and Symbolism,' was the topic for discussion. After some introductory remarks by Dr. J. B. Kinley, Colonel U. S. Hollister spoke at length on the subject, illustrating his remarks by about sixty-five blankets from his own private collection. He described their system of weaving, use of dyes, and the meaning of the symbols.

Dr. A. L. Bennett delivered a lecture at the 33d meeting on the 'Value of the Cranial Capacity as Indicating the Degree of Intelligence Enjoyed by the Prehistoric Cliff Dwellers of our Great Southwest.' Dr. Bennett, in addition to being chairman of the Section of Anthropology and Ethnology of the Colorado Academy of Science, is also a fellow of the Anthropological Institute of Great Britain and Ireland. Dr. Bennett has spent considerable time examining and measuring the cranial capacity of the large collection of the Cliff Dweller skulls from the Mancos region, Colorado, in the museum of the State Historical and Natural History Society of Colorado. From data obtained in these measurements he gives them a higher grade of intelligence than has been accorded by some to these primitive people.

Mrs. W. S. Peabody read a paper on the 'Work and Plans of the Cliff Dwellings Association,' being an interesting review of efforts made to preserve from vandalism and the relic hunter the prehistoric ruins of the Southwest.

WILL. C. FERRIL,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE PUBLICATION OF REJECTED NAMES.

I WISH to speak quite respectfully of Mr. T. D. A. Cockerell; but surely systematists would be much happier if he and his like did not raise such disturbing questions as that in SCIENCE for January 30, p. 189. Had he chosen to condemn Messrs. Banks and Knowlton, first for wasting time, ink and paper over names that they never intended to use, secondly for presumption in substituting their own inventions for those of Marx and Lesquereux, then one would have applauded him. But all he objects to in them is that they inadvertently happened to print the so-called MS. names a page or so ahead of the new names proposed by themselves. Mr. Cockerell does not attempt to prove that the MS. names were published five minutes earlier, and it is clear that the publication of the old and new names was simultaneous in each paper. The precise number of pages, lines, or words that intervened can make no difference. Suppose that Mr. Banks had written as follows: "For this species of *Filistrata* there is a choice of two names: *F. oceanea* and *F. fasciata*. The name *F. oceanea* has been found on an unpublished label, but since in my opinion it is inappropriate, I shall call the species *F. fasciata*." Now to be consistent, Mr. Cockerell would have to insist that in writing thus Mr. Banks contravened the rules of nomenclature, because he introduced *oceanea* first. 'An two men ride of a horse, one must ride behind.' Surely an author does not lose his freedom of choice before he

has finished posing the question? On the contrary, I regard the names *F. oceanea* and *F. fasciata* as equal in their pretensions, until the choice is made. Once made, the person that attempts to upset it is the true begetter of confusion.

But does Mr. Cockerell's conclusion follow from his premises? The conception underlying his application of the law of priority is that place is to be reckoned as time. Now a specific name has no standing until a description of the species denoted thereby has been published, and until the name in question has been associated therewith. Till then it is a *nomen nudum.* The name *Filistrata oceanea* is, we are told, a *nomen nudum.* Even had it been published in a previous paper, it would, in the absence of a description, have remained a *nomen nudum.* It appears first on page 50 of Mr. Banks' paper, but without description; and it remains without description for five whole pages. During all this space, it remains a *nomen nudum.* Mr. Banks may asseverate as often as he pleases that *F. oceanea* is identical with *F. fasciata.* But *F. fasciata* does not exist (for Mr. Cockerell), except as a *nomen nudum,* till page 55 is reached. Here is a description at last; but the name associated with that description is not *F. oceanea* but *F. fasciata.* It is this latter then that ceases first to be a *nomen nudum.*

The case of *Cucumites lesquereuxii* Knowlton is different; but even this may, on Mr. Cockerell's principles, be defended. For it follows from the axiom 'place = time' that every name is a *nomen nudum* until the diagnosis or description is complete. But the description of the fruit under discussion once finished, Mr. Knowlton calls it, not *Cucumites globulosus,* but *C. lesquereuxii.*

Mr. Cockerell may retort that this is mere hair-splitting and childish chop-logic. It is. But it is the natural outcome of an attempt to subject mere modes of expression to a rule obviously intended to apply to essential matters and not to the niceties of style.

To save all misunderstanding, let me repeat emphatically that I am not defending either Mr. Banks or Mr. Knowlton. I have no sympathy with people who print names for the mere sake of rejecting them, or who tell us what they might have done or what somebody else might do if circumstances had been different, and so forth. If such action be in any degree checked by Mr. Cockerell's arguments, their publication will have had one good result.

F. A. Bather.

MOTION OF TRANSLATION OF A GAS IN A VACUUM. (REPLY TO MR. R. W. WOOD.)

In the hope that if I bring around Mr. R. W. Wood to my view of the energy required to set a gas in motion of translation in a vacuum, he will not find my explanation of the energy changes which take place when a gas expands into a vacuum unnecessary, I will only take up here that view.

Mr. Wood in his second note (Science for December 5) on a communication of mine to the American Association says:

> We sometimes find the statement in text-books that a gas expanding under such conditions that no work is done experiences no cooling, for example, when expanding into an infinite vacuum. It appears questionable, however, whether a gas can expand without doing work. Leaving out of consideration the internal work, *i. e.,* the overcoming of the forces of cohesion, we still have the gas in the receiver doing work in giving a motion of translation to the mass of gas thrown out into the vacuum.

I think, however, that it can be proved that no work is necessary to set a gas in motion of translation in a vacuum by the following reasoning. Suppose that in a body of gas all the molecules move with the same velocity instead of having, as we assume according to the kinetic theory, velocities varying greatly in magnitude, and that the identical velocity of all the molecules plays in other respects the same part which we attribute to the mean molecular velocity, *e. g.,* that to each degree of temperature of a gas a fixed velocity corresponds, etc. Let that gas be compressed in a receiver and then allowed to enter a vacuous vessel which communicates with the latter. What will happen? To my mind, it can hardly be conceived that anything else could take place than the uniform distribution of the

gas in both vessels, the same temperature obtaining throughout its entire mass. For how could a difference of temperature result when no other action between the molecules is possible than their collisions with one another, collisions which cannot affect the molecule's kinetic energy (the kinetic energy of each molecule being the same according to our supposition). But if it is admitted that in the supposed case the two vessels will be filled uniformly with the gas at the same temperature throughout, it is also admitted that a portion of the gas was set in motion of translation without any work having been done.

The only objection that could be raised to the above reasoning is perhaps this: the gas, while compressed in the receiver, has motion of agitation and, after equilibrium is established upon a portion of the gas having entered the vacuous vessel, it has again the same motion of agitation, but while passing from the receiver into and through the vacuous vessel a portion of the gas had, in addition, motion of translation which must be superimposed on the motion of agitation. There thus seems to be here a plus of energy to be accounted for. But this objection can be met by considering more closely the three stages in time which the phenomenon of the expansion of a gas into a vacuum presents. First, in the compression chamber all the gas has only motion of agitation, then while traversing the vacuous vessel the respective portion of the gas has only or mainly motion of translation at the expense of its original motion of agitation; and lastly, on striking the walls of the empty vessel the incoming gas has its motion of translation reconverted into motion of agitation.

If the above reasoning is correct, it means that just as to set one gas molecule in motion of translation in a vacuum does not require anything else than its own motion of agitation (which will, I believe, be admitted by every one), so with a body of gas.

But if in the hypothetical case no change in the magnitude of the kinetic energy of the individual molecules is required to 'translate' (if I may use the expression) a portion of the molecules, why should it be necessary in the actual case as understood on the basis of the kinetic theory? It is true that we observe here a redistribution of energy and a 'translation' of a portion of the gas, but this 'translation' would have taken place if there were no redistribution of energy.

PETER FIREMAN.

WASHINGTON, D. C.

WILL-MAKING.

TO THE EDITOR OF SCIENCE: The ever-recurring contests of wills, the disputes as to their validity, their meaning in general and particular, the interpretation of their peculiarities and seeming inconsistencies, etc., are such a damage to private comfort and to the public welfare in the highest sense, that any means of lessening the growing evil must be welcomed by all concerned.

As part remedy at least, I would suggest the establishment by each state of a court or other properly constituted body, whose duty and business it should be, upon application, to consider and validate *during the lifetime of the testator* his will, which, after approval could be deposited with the necessary secrecy, as a thoroughly competent legal instrument. To change a will, the same process should be gone through again. This presentation, validation and placing on record should absolutely bar all actions designed to break or alter the will after the death or subsequent incapacity of the testator. The way in which the Torrens land-title has been instituted in some countries is, if not a precedent, an instance of the successful treatment of a kindred difficulty. An unbreakable will might turn out to be as great a boon as an indefeasible title.

ALEXANDER F. CHAMBERLAIN.

CLARK UNIVERSITY, WORCESTER, MASS.,

[It is said of Charles Darwin in the 'Life and Letters': 'He would declare energetically that if he were law-giver no will should be valid that was not published in the testator's lifetime.' It is not clear how a secret will could be validated in the manner suggested by Professor Chamberlain, but there appears to be no reason why it should not be possible to probate a will during the lifetime of the testator. Such legal and moral scandals as

the subversion of the intentions of Stewart, Tilden, Fayerweather and others would thus be rendered impossible.—EDITOR.]

SHORTER ARTICLES.

SLEEPY GRASS AND ITS EFFECT ON HORSES.

IN the Pecos Valley of New Mexico a year ago, a ranchman told me of a strange kind of grass found in the Sacramento Mountains west of there which, from its peculiar effect on horses, is called 'sleepy grass.' He described it as differing from the locoes in merely putting horses into a deep sleep without other symptoms of poison.

The story had a far-away sound and made little impression at the time, but last September, as I was traveling along the crest of the Sacramento Mountains, it came back to me with a new interest.

We had made camp one evening in a beautiful park, bordered with spruces and firs, and covered with tall grass that, with its green base leaves and ripe heads loaded with heavy rye-like grain, offered a tempting feast to our hungry animals. The moment saddles and harness were off, the horses were eagerly feeding. A few minutes later a passing ranchman stopped his team and called over to us, 'Look out there! Your horses are getting sleepy grass,' and added, 'If they get a good feed of that grass you will not get out of here for a week.' We were not prepared to spend a week in that locality, but I was anxious to test the grass, so let the horses feed for a half hour, then brought them up for their oats and picketed them on some short grass on a side hill well out of reach of the sleepy grass.

The following morning just after sunrise the cook called my attention to the attitude of one of the team horses, saying there was 'sure something the matter with old Joe.' The horse was standing on the side hill, asleep, his feet braced wide apart, head high in air, both ears and under lip dropped, a most ridiculous picture of profound slumber. The other horses apparently had not eaten as much of the grass as old Joe, for they were merely dozing in the morning sun and showed signs of life in an occasional shake of the head or switch of the tail. At breakfast time the others woke up to a keen interest in their oats, but old Joe, after being dragged to camp much against his will, preferred to sleep rather than eat, and after pulling back on his rope all the way down to the spring, refused to drink or even lower his head to water. My little saddle mare showed the least signs of the general stupor, so dropping behind with her, I woke the others up pretty thoroughly and brought them into camp on a lope. Later, when in the harness, the team traveled along steadily with some urging, but when we reached Cloudcroft and left the horses in front of the store while getting supplies, their heads dropped, and for an hour they slept soundly. Even my nervy little mare did not move from her tracks, but stood with drooping ears, paying no attention to the unusual surroundings and stir of a town. On starting again the saddle horses responded to the spurs with worried switches of the tail quite different from their usual manner, while the team paid no greater attention to the whip. For the rest of the day our progress was slow, notwithstanding which, the driver called my attention to the fact that the team, and especially old Joe, were sweating profusely. Our saddle horses would sigh with relief when allowed to stop for a moment, and we had many a good laugh at the flapping ears of my companion's horse—a large-eared, raw-boned cayuse which seemed to have lost all control of her usually erect ears.

That night we camped in another park-like valley where sleepy grass was abundant, but took care to picket the horses out of reach of it. They were hungry and all began to feed eagerly, but old Joe soon stopped, braced his feet and relaxed into forgetful slumber. The next morning when we went to bring them in for their grain all were fast asleep.

The stupor lasted about three days, and was too evident and unusual to be attributed to weariness or natural indisposition. We were making easy trips and the horses were in good condition. After it wore off they showed their usual spirit and energy, as well as appetite. The only after-effect was a gaunt appearance, apparently resulting from lack of

energy to get their usual amount of grass. Old Joe had even refused his grain for about half the time.

It should be remembered that our horses had but a small amount of the grass. The ranchmen told us that other travelers coming into the country had been obliged to camp for a week while their horses slept off the effect of a good feed of it, and while its effects usually lasted for a week or ten days, it did no more serious damage than to leave the animals thin from fasting. Stories were told of horses being lost in the mountains and found several days later in the bushes near camp fast asleep.

I have offered no real proof that this particular species of grass is what affected our horses. They undoubtedly ate a dozen other species of grass, as well as some other plants, every day while we were in the mountains. But after our experience I am inclined to give credit to the uniform statements of the ranchmen in regard to it. All agree on the species, on its effects, and to the fact that after one good dose of sleepy grass, horses will never touch it again. This latter statement has ample proof. Horses and cattle are ranging in many of the valleys where it grows in abundance, untouched and full of ripe seed, while the other grasses are cropped close all around it. I did not see horses or cattle touch it except in the case of our own animals and the team of another traveler from the valley, all of which ate it eagerly. They ate both the base leaves and the heads that were full of ripe seeds. I shelled out and ate a handful of the seeds, but without noticeable effect. The ranchmen generally agree that it is the leaves which produce the sleepiness.

I did not hear that cattle were affected by it, but they certainly avoid it, as many were grazing near where it stood untouched.

While this experience was new to me, I find that sleepy grass has long been known to botanists as such, or technically as *Stipa vaseyi*. Something has been known of its effects on horses, but apparently its chemical properties have not yet been determined.

VERNON BAILEY.

THE VERTEBRAL COLUMN OF BRONTOSAURUS.

ALTHOUGH the genus *Brontosaurus* Marsh has been known from the greater part of the skeleton for more than twenty years, many points of interest concerning its structure remain undetermined. The Field Columbian Museum Expedition of 1900 was fortunate in securing a large part of a skeleton of one of these great reptiles in such a state of preservation that the bones of the torso and base of the tail were scarcely disturbed from their relative positions. This splendid specimen, which is now almost ready for exhibition, makes it possible to determine the vertebral formula of the thoracic and anterior caudal regions, as well as many other minor features.

The specimen consists of eleven presacral vertebræ, five coalesced sacral, and twenty-three caudal vertebræ, with pelvis, ribs and chevrons almost intact. The eleventh presacral was exposed and partially broken away when found. From that point backward the thoracic, sacral and caudal vertebræ, as far as caudal XIII., were lying in a close series, with their centra nowhere displaced more than two or three inches. Most of the ribs and many of the chevrons were also found in position.

The specimen throughout agrees very closely, both in size and in character, with Marsh's type, *Brontosaurus excelsus*. However, it shows that with regard to the thoracic region his final restoration was considerably at fault. In fact his first figure* shows the thorax much more nearly correct. Counting the five coalesced vertebræ as sacral, the thoracic series in this specimen is made up of ten rib-bearing vertebræ. The eleventh, as before stated, has been partially lost, but enough remains to show that the transverse process is replaced by a cervical rib. A noticeable reduction in size of the rib facets on presacral X together with the much-reduced neural spines on presacral XI., bears out the conclusion that the latter is the posterior cervical. We may, therefore, conclude that the number of thoracic vertebræ in this genus is ten instead of fourteen as estimated by Marsh.

The crest of the dorsal arch was evidently

* *Am. Jour. Sci.*, Vol. XXVI., pt. I.

just in front of the sacrum, where the dorsal spines reach their greatest length. From this point they rapidly fall away in both the caudal and the thoracic series. In the fourth presacral the first evidence of bifurcation appears in a slight concavity on the posterior margin of the spine. In the eighth, bifurcation is complete, the median spine being replaced by two slender and laterally directed processes. In the eleventh presacral, or posterior cervical, these lateral spines are reduced to mere rudiments.

The anterior caudal series departs less widely from that represented in Marsh's restoration. Indeed, the gradual reduction of the series posteriorly offers no reliable basis of comparison. The first caudal may be readily recognized by the semi-concave, semi-convex anterior surface of the centrum. It is also but little excavated laterally. The four succeeding caudals are more or less excavated at the base of the transverse processes. In one or two instances these fossæ descend deeply into the centra, but as they are sometimes present on one side and absent on the other they can not be regarded as constant characters. However, as Marsh has estimated the first caudal having a solid centrum as caudal IV., it is quite probable that three vertebræ, instead of one, were missing in his specimen from the anterior end of the series. On the other hand, Dr. Osborn has probably erred on the side of estimating the number of anterior caudals as too great, if indeed the specimen described by him* as *Camarasaurus* syn. *Brontosaurus* may be regarded as belonging to this genus at all.

The centra of the anterior caudals are markedly procœlous in form, but as they diminish in size and complexity this character disappears, so that in the region of the fifteenth they become irregularly amphiplatyan. The transverse processes are rapidly reduced in size, from broad flattened plates to peg-like processes, and disappear entirely with the twelfth.

As has been pointed out by Osborn and by Hatcher with regard to *Diplodocus*, the three types of chevrons (viz., the closed arch, the open arch and the double arch types) are all found in *Brontosaurus*, ranging in the order named from the anterior end of the series backward. The presence of a short, stout, closed chevron imbedded in the matrix below the first caudal suggests that the whole series may have been chevron-bearing. As the double arch pattern is also known to occur in *Morosaurus*, the three types may be regarded as characteristic of the Sauropoda.

A complete description of this splendid specimen will be given in an early issue of the museum publications. E. S. Riggs.

Field Columbian Museum,
January 10, 1903.

* *Bull. Amer. Mus. Nat. Hist.*, Vol. X., p. 219.

AMERICAN MUSEUM OF NATURAL HISTORY.

At the annual meeting of the Board of Trustees of the American Museum of Natural History, New York, on Monday evening, February 9, announcement was made in the President's report of many notable accessions to the collections of the Museum during the year 1902. Among the most important accessions are the following:

The Cope collection of fossil reptiles, amphibians and fishes, and the Robinson collection of archeological copper inplements, the two collections being gifts of the President.

Many rare and superb specimens have been added to the J. Pierpont Morgan collections of gems and gem minerals, and the Museum is indebted to the same donor, Mr. Morgan, for a type collection of gold and silver coins of the United States Mint.

The Duke of Loubat has presented a collection of ancient jadeite ornaments from Mexico and a valuable ethnological collection from Brazil.

The material received through the expeditions, supported by the Museum and through special gifts, has yielded gratifying results. Among the noteworthy expeditions are:

The William C. Whitney expedition in search of fossil horses.

The researches carried on in Mexico through the contributions of B. T. Babbitt Hyde and Frederick E. Hyde, Jr.

The archeological research carried on in the

Delaware valley at the expense of Dr. Frederick E. Hyde, and the field work among the vanishing tribes of the North American Indians, supported mainly through the contributions of Mrs. C. P. Huntington and Archer M. Huntington.

The Jesup North Pacific Expedition has yielded a large quantity of material.

The Eastern Asiatic Research expedition, maintained through the assistance of a friend of the Museum, has added to the collections a series of valuable and interesting objects illustrating the culture of China.

The expedition under Andrew J. Stone, who has been collecting specimens of the large fur-bearing animals in the far north, has enriched the Museum collections with many specimens of caribou, bear, deer and sheep, which will be utilized in the preparation of groups of the animals, represented with their natural environment.

A large quantity of material has been received from Commander Robert E. Peary, through the Peary Arctic Club.

The library of the Museum has received many gifts of desirable works, the most noteworthy being a gift of 287 volumes on conchology, for which the Trustees are indebted to Frederick A. Constable.

President Jesup referred to the loss to the Board in the death of Abram S. Hewitt, who had been a Trustee since 1874.

The officers for the year are:

President—Morris K. Jesup (Twenty-third term).

First Vice-President—J. Pierpont Morgan.

Second Vice-President—Professor Henry Fairfield Osborn.

Treasurer—Charles Lanier.

Director—Dr. Hermon C. Bumpus.

Secretary-Assistant Treasurer—John H. Winser.

*THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH.**

THE Rockefeller Institute for Medical Research was founded in 1901, by Mr. John D. Rockefeller, who gave for this purpose the sum of two hundred thousand dollars. The aims of the institute are the promotion of medical research, with especial reference to the prevention and treatment of disease.

It was thought wise by the directors of the institute not, at first, to concentrate the work in any one locality, but to enlist the interest and cooperation of such investigators throughout the country as might be engaged in promising researches or who might enter upon new fields if suitable pecuniary assistance could be afforded them. It was the conviction of the directors that in this way it would be possible not only to stimulate and foster valuable contributions to science, but also to secure important practical suggestions as to the lines along which the institute might most wisely develop.

Among the large number of applications for assistance in carrying on original studies which relate to the cause, prevention and cure of disease, and to the problems upon which new knowledge on these subjects must be based, over twenty have been selected. The directors have secured counsel in these selections from the heads of departments or others in the universities of Harvard, Yale, Johns Hopkins, Pennsylvania, Columbia, New York, Chicago, Michigan, McGill, Wesleyan, California and Western Reserve; and in many of these institutions work has been prosecuted. Two of the Rockefeller fellows have been working in Europe. Some of the workers under these Rockefeller Institute grants, which vary in amount from two hundred to fifteen hundred dollars, have completed and published their investigations; some are still engaged upon them.

It is the purpose of the directors, from time to time, to bring together in the form of volumes of collected reprints, the results of these researches which may be published in various technical journals. An arrangement has been effected by which the institute will assume the publication of the *Journal of Experimental Medicine* which will remain under the editorial supervision of Dr. William H. Welch, professor of pathology in the Johns Hopkins University, and president of the board of directors of the institute.

At the end of the first year of practical

* A statement sent us by the secretary of the institute, Dr. L. Emmett Holt.

work of careful study of the situation, it became clear to the directors that existing institutions in this country, while in many instances carrying on most valuable researches in medicine, do not afford adequate facilities for many phases of investigation which are of the utmost importance and urgency. This is in part due to the lack of sufficient endowment, in part to the large demands made upon the time and energy of the workers by their duties as teachers. It was further evident that such assistance as the institute had thus far been enabled to extend to selected investigators in various parts of the country had fostered work of great actual value, as well as of high promise, and should be perpetuated along similar lines.

The directors, however, were united in the conviction that the highest aims of the institute could not be secured in this way alone. Useful as such individual studies are and important as it is to enlist and to maintain the interest of research workers in established institutions of learning, it is not possible in this way to secure the unity of aim and the coordination and mutual stimulus and support which are essential to the highest achievements in research. These are to be secured, it was believed, only by the centralization of certain lines at least of the work of the institute under a competent head or series of heads of departments, in a fixed place, with adequate equipment and permanent endowment.

There is no lack of men of sufficient training and experience ready to devote their lives to the solution of medical problems which bear directly or indirectly upon the welfare of mankind. The widely open fields of research are many. Some of these relate to the application of existing knowledge to the prevention and cure of disease; others to the development of new knowledge along various lines of science which more than ever before give promise of great significance in the problems of physical life.

In a broad sense, the directions and methods for the study of disease may be classified as morphological, physiological and chemical; and the institute, it was thought, should include departments providing for these divisions of the subject. For the morphological study of disease there should be a complete equipment for pathological-anatomical research. For the physiological study of disease provision should be made for experimental pathology, for pharmacology and therapeutics, for the study of bacteria and other microorganisms with especial reference to their relation to the infectious diseases, and for other investigations in personal and public hygiene, including preventive medicine. Here belong especially the problems of infection and immunity, and here also, in large part, such studies as require access to patients in hospitals. There should be a laboratory, well equipped for investigations in physiological and pathological chemistry.

It was the conviction of the directors that such an institute might wisely add to its aims in the direct increase of the knowledge of disease and its prevention and cure, a phase of activity which should look toward the education of the people in the ways of healthful living, by popular lectures, by hygienic museums, by the diffusion of suitable literature, etc. For, in fact, the existing agencies for medical research for the most part stop short of those direct and widely diffused applications of newly won knowledge upon which the immediate practical fruitage of their work so largely depends.

In order that the causes and treatment of human disease may be studied to the best advantage, it was the opinion of the directors that there should be attached to the institute a hospital for the investigation of special groups of cases of disease. This hospital should be modern and fully equipped, but it need not be large. It should attempt to provide only for selected cases of disease, and the patients would thus secure the advantages of special and skilled attendance and such curative agencies as the institute might develop or foster.

It was thought that an institute for medical research of the largest promise would require a central institution, fully equipped and endowed, and with capacity for growth, in which the more comprehensive studies demanding

the coordinated forces of various phases of science could be carried on from year to year; while at the same time, by means of such grants of assistance as had been offered during the initial year, it should continue to make available the resources of special workers all over the country, as well as in Europe.

In view of the above considerations relating to its future, in June, 1902, Mr. Rockefeller gave to the institute the sum of one million dollars for the purchase of suitable land, the erection of buildings, and the organization of a working force along the broader lines which had been projected. It is the purpose of the directors to proceed at once to the erection of a laboratory building which will provide for the present requirements and will be capable of enlargement as the character and extent of the work of the institute may develop. Negotiations for a suitable plot are now under way.

A small hospital will also be built in the immediate future, which will be maintained in close association with the experimental work of the institute.

Provision will be made in the laboratory building for research in physiological chemistry, pharmacology and therapeutics; in normal and pathological physiology; and in various phases of morphology; and for the study of bacteria and other microorganisms. It is hoped that the laboratory buildings may be completed and ready for the commencement of work in the autumn of 1904.

Dr. Simon Flexner, professor of pathology in the University of Pennsylvania, will direct the scientific work when the building is completed. His colleagues deem it of the highest importance that the institute has been able to secure so eminent an investigator as Dr. Flexner to shape the work of its early years. Dr. Flexner will spend several months abroad while the new buildings are in course of erection.

It is proposed to organize the various sections and departments into which the work of the institute will naturally fall so that each of them, though in a measure autonomous, will still be so closely associated as to favor the conjoint investigation of comprehensive problems. Associated with the head of each of these departments it is proposed to have a staff of trained assistants.

Provision will also be made for research work by a group of trained men, to be designated fellows, scholars, etc., of the institute, under pecuniary grants of varying amounts.

Finally, opportunity will be afforded to suitable investigators, not members of the regular staff of the institute, to pursue special lines of research.

The directors of the institute are:

Dr. William H. Welch, Baltimore; Dr. T. Mitchell Prudden, New York; Dr. Theobald Smith, Boston; Dr. Simon Flexner, Philadelphia; Dr. Hermann M. Biggs, New York; Dr. C. A. Herter, New York; Dr. L. Emmett Holt, New York.

The officers are:

President—Dr. William H. Welch.
Vice-President—Dr. T. Mitchell Prudden.
Secretary—Dr. L. Emmett Holt.
Treasurer—Dr. C. A. Herter.

SCIENTIFIC NOTES AND NEWS.

DR. J. H. VAN'T HOFF, professor of chemistry at the University of Berlin, has been elected a corresponding member of the Academy of Sciences at Munich, and an honorary member of the Philosophical Society of Cambridge.

M. E. MASCART has been elected a member of the International Committee on Weights and Measures.

THE Lucy Wharton Drexel medal of the University of Pennsylvania was presented to Professor F. W. Putnam at the Founder's Day celebration on February 21. The medal was established four years ago, but no awards were made until this year, when four were awarded at one time. The other three to receive the medal are: Professor Petrie for his work at Abydos; Professor Evans for his excavations at Crete; and Professor Hilprecht for work in Babylonia. Hereafter one medal will be awarded each year 'for the best excavations in archeology or for the best publication, based on archeology, by an English-speaking scholar.' Next year the medal will

be awarded by the first four recipients to one whom they deem the most worthy.

Dr. J. Walter Fewkes, of the Bureau of American Ethnology, who has been in Porto Rico since last November, has sent a large number of valuable specimens to Washington.

Messrs. William K. Wright and W. K. Palmer, of the Lick Observatory, left San Francisco on February 28 for Santiago, Chili, where astronomical observations will be made in accordance with the plan we have already announced. The expenses, it will be remembered, are defrayed by Mr. D. O. Mills.

Lieut. Boyd Alexander has returned from an expedition to the Island of Fernando Po in continuation of his survey of the birds of western Africa and the adjacent islands. His collection represents sixty-eight species, of which no fewer than thirty-two are new to science.

Mr. Stewart Culin, recently curator of the Museum of Science and Art of the University of Pennsylvania, has become curator of ethnology to the Museum of the Brooklyn Institute of Arts and Sciences.

Dr. A. S. Grünbaum, F.R.C.P., has accepted the post of director of cancer research at the invitation of the committee appointed to administer the fund initiated for that purpose by a gift of £10,000 from Mr. Sutton Timmis of Liverpool. The work will be carried on at the University College and Royal Infirmary in Liverpool.

Dr. W. H. C. Redeke has been appointed director of the Zoological Station at Helger, Holland, in place of Dr. P. C. C. Hoek, who has become general secretary of the International Bureau of Oceanography at Copenhagen.

Dr. Eduard Zeller, emeritus professor of philosophy at Berlin, has recently celebrated his eighty-ninth birthday.

Dr. J. Bishop Tingle, professor of chemistry at Illinois College, Jacksonville, Ill., has received a grant of $500 from the Carnegie Institution to enable him to continue his investigations of derivatives of camphor and allied compounds.

The Academy of Sciences at Berlin has made appropriations of 2,000 Marks to Professor Landolt and of 1,500 Marks to Dr. Marckwald, both of Berlin, for work in chemistry; of 1,000 Marks to Dr. Danneberg, of Aachen, for work in mineralogy, and of 800 Marks to Professor Kobert, of Rostock, for work in pharmacology.

Dr. H. W. Wiley, chief of the Bureau of Chemistry of the Department of Agriculture gave a lecture before the American Philosophical Society in Philadelphia, on February 6, on 'The Composition and Adulteration of Foods'; before the Society of Medical Jurisprudence at New York, on February 9, on 'The Adulteration of Drugs and Laws Relating Thereto'; before the National Canners' Association at Washington, on February 12, on 'Chemical Problems relating to the Canning Industry'; and before the National Geographic Society at Washington, on February 18, on 'The United States: its Soils and their Products.'

Mrs. Rowland has given to the Johns Hopkins University the library of the late Professor Rowland relating to spectroscopy, and a former student has given a fund of over $5,000 to purchase books on this subject. With these gifts, there will be established a 'Henry A. Rowland memorial library' to contain publications in the field of radiation and spectroscopy. To make the collection complete, and to maintain its usefulness, the coöperation of observatories, laboratories and investigators is necessary. It is requested that sets of official publications, books, reprints of papers on spectroscopy or allied subjects, and photographs of spectra and of apparatus will be contributed to the library, both now and in the future. They may be addressed to the care of Professor Joseph S. Ames, director of the Physical Laboratory, Johns Hopkins University, Baltimore, Md.

Professor Czerny, son-in-law of the late Professor Kussmaul, has had the house at Kandern, where Kussmaul lived in his early years, marked with a tablet with the following inscription: 'Adolf Kussmaul, later Professor

at Erlangen, Heidelberg, Freiburg, and Strassburg, practised here, 1850–1853.'

REAR-ADMIRAL WILLIAM HARKNESS, U.S.N. (retired), the eminent astronomer, president of the American Association for the Advancement of Science in 1893, died on February 28 of typhoid fever, in his sixty-sixth year.

RICHARD JORDAN GATLING, inventor of the gun that bears his name and of various agricultural implements, died on February 26, in his eighty-fourth year.

MRS. M. L. D. PUTNAM, of Davenport, Iowa, died on February 20. Mrs. Putnam was president of the Davenport Academy of Sciences and a fellow of the American Association for the Advancement of Science.

WE regret also to record the death of Dr. Charles Dufour, professor of astronomy at the University of Lausanne, and of Dr. René Thomas Mamert, professor of chemistry at the University of Freiberg, in Switzerland.

MR. HENRY PHIPPS, of New York, has given a further sum of $50,000, making $60,000 in all, for the promotion of scientific work in India. It is said that the money will be used for a Pasteur Institute in southern India and for an agricultural laboratory in Cashmere.

THERE will be a civil service examination on March 24 to fill the position of assistant curator in the division of physical anthropology in the National Museum at a salary of $1,800. On the same day there will be an examination for the position of laboratory assistant in the Bureau of Soils, Department of Agriculture, at a salary ranging from $840 to $1,200.

A BOSTON chapter of the American Institute of Electrical Engineers was established at the Massachusetts Institute of Technology on February 13, Professor Elihu Thomson presiding.

THE United States has been invited to take part in an agricultural congress, which will be held at Rome from April 19 to 23.

THE Davenport Academy of Science is having a loan exhibit of objects illustrating weaving. Among over 250 specimens on exhibition are some rare Aleutian, together with fine Alaskan and Californian baskets. In connection with the basketry exhibit is shown a collection of Navajo blankets, Mexican mats and ethnological specimens from the South Sea Islands and Manila.

THE *Geographical Journal* states that the Swedish expedition which went last summer to Spitzbergen to complete the operations for the measurement of an arc of the meridian, left unfinished the preceding year owing to unfavorable weather conditions, returned during the autumn after successfully accomplishing its task, a junction being effected with the Russian net of triangles in the more southern parts of the group. The operations were begun in 1898, and had, therefore, occupied in all no less than five summers.

WE learn from the London *Times* that in order to encourage investigations into the increase of fertility in soils by the action of bacteria and other micro-organisms, under the influence of mineral manures, with special reference to manuring with basic slag, Verein der Thomasphosphatfabriken has instituted a competition, with prizes amounting to a total of £1,950. Scientific essays and experiments conducted by practical farmers will be admissible in the competition. The method of treatment of the subject is left to the discretion of each competitor. The competition is to be open to all, without regard to nationality. The following five gentlemen have consented to act as judges, any of whom will be pleased to give particular information to intending competitors: Government-Adviser Dr. L. Hiltner, principal of the Royal Agricultural and Bacteriological Institution, Munich; Professor Dr. Alfred Koch, principal of the Royal Agricultural and Bacteriological Institution, the University, Göttingen; Professor Dr. Remy, principal of the Institute for Researches and Bacteriology, the Royal Agricultural University, Berlin; Professor Dr. A. Stutzer, principal of the Royal Agricultural Chemical Institute, the University, Königsberg; and Professor Dr. H. Wilfarth, principal of the Ducal Agricultural Experimental Station, Bernburg. Competitors are requested to send in their essays, written in German, to the association, not later than February 1, 1906, by registered post.

UNIVERSITY AND EDUCATIONAL NEWS.

At the recent meeting of the trustees of Cornell University President Schurman announced an anonymous gift of $150,000 for the establishment of a pension fund.

Mr. James B. Colgate, of New York, has given $100,000 to Colgate University, Hamilton, N. Y., to which he had already given over $1,000,000.

Mr. Andrew Carnegie has given $100,000 to Western Reserve University for the establishment of a school for the training of librarians.

A gift of $250,000 was made last spring to Teachers College, Columbia University, for the construction of a building for physical education and school hygiene. It is now announced that the donor is Mrs. Frederick F. Thompson, one of the trustees of the college.

Last week we announced that Professor Sylvester Waterhouse, at the time of his death emeritus professor of Greek at Washington University, had bequeathed $25,000 to the university, the interest to accumulate until the year 2000, and had made other bequests. We are informed that this is not quite correct, Professor Waterhouse having given $25,000 to Washington University in 1895 on condition that he should be paid five per cent. interest during his life and that the gift should be kept secret until at least one year after his death. The money is to accumulate until the year 2000 or until the fund amounts to $1,000,000. Under somewhat similar conditions Mr. Waterhouse had given $5,000 to Harvard University, to Dartmouth College, to Phillips-Exeter Academy and to the Missouri Historical Society.

Mr. R. B. Keyser, president of the board of trustees of the Johns Hopkins University, has given $5,000 to make plans for improving the new site of the university.

Columbia University receives $10,000 for the establishment of a scholarship by the will of Mrs. Ellen Josephine Banker.

At Cornell University Professor L. H. Bailey has been appointed director of the college of agriculture and dean of faculty of agriculture, to succeed Professor I. P. Roberts, retired; Professor L. M. Dennis, head of the department of chemistry, to succeed Professor Caldwell, retired; Assistant Professors W. R. Orndorff, W. D. Bancroft and E. Merritt have been promoted to professorships of organic and physiological chemistry, physical chemistry and physics, respectively.

At the University of Nebraska, Dr. Raymond G. Clap has been appointed professor of physical education, and Dr. Ralph S. Lillie instructor in physiology; Dr. Edgar L. Hinman has been promoted to a full professorship and Dr. Thadeus L. Bolton to an adjunct professorship in philosophy; Robert E. Moritz has been promoted to an assistant professorship in mathematics, and Burton E. Moore to a full professorship of physics.

Dr. D. J. Cunningham, F.R.S., professor of anatomy in the University of Dublin, has been elected to the chair of anatomy in the University of Edinburgh, vacant by the promotion of Sir William Turner to the principalship. Dr. Cunningham is a graduate of the University of Edinburgh and was for some years demonstrator in anatomy under Sir William Turner.

At Cambridge University Mr. T. Manners-Smith, Downing, and Dr. H. W. Marett Tims, King's, have been appointed demonstrators of anatomy. Mr. W. A. Cunnington, Christ's, has been appointed to the university table in the Naples Zoological Station. Dr. D. MacAlister, Professor Woodhead and Dr. Nuttall have been appointed representatives of the university at the International Congress of Hygiene and Demography to be held at Brussels in September. The following have been appointed electors to the respective chairs specified: chemistry, Dr. T. E. Thorpe; anatomy, Dr. Allbutt; botany, Mr. A. Sedgwick; Downing (medicine), Dr. A. Macalister; zoology, Dr. D. MacAlister; physics, Lord Rayleigh; physiology, Professor G. S. Woodhead; surgery, Dr. A. Macalister; pathology, Dr. W. H. Gaskell.

Professor Loewinson-Lessing, of Dorpat, has been elected professor of geology in the Polytechnic Institute at St. Petersburg.